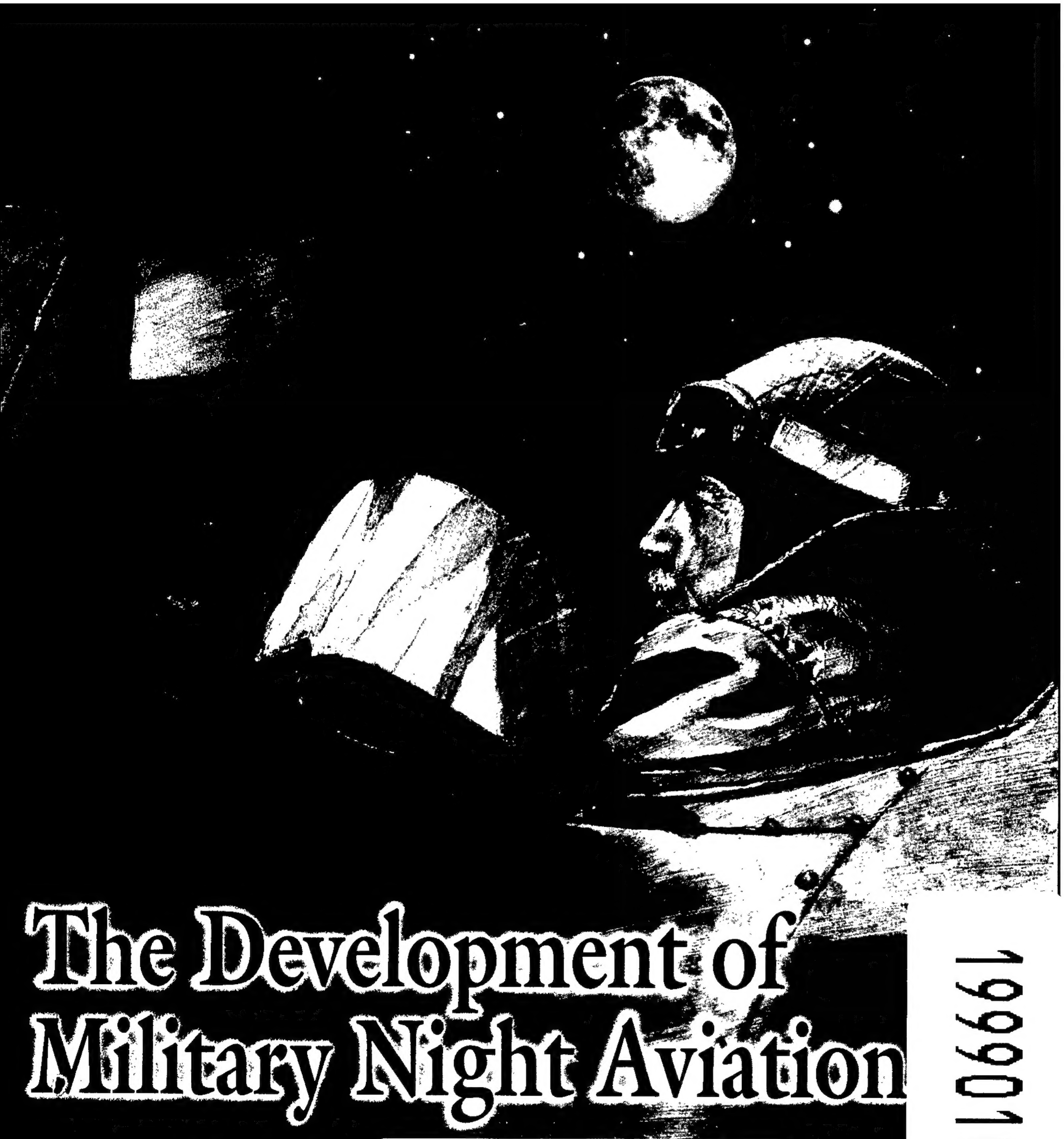

The Development of Military Night Aviation to 1919

William Edward Fischer Jr.

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WILLIAM EDWARD FISCHER JR.

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About the Author

Maj William E. Fischer Jr., USAF, is an air and air defense capabilities analyst serving on exchange with the staff of the Canadian Forces Director General of Intelligence at National Defence Headquarters in Ottawa. Enlisting in 1976, he became an Air Weather Service observer, with tours in Ohio and Alaska followed by duty at Fort Bragg, North Carolina, where he completed parachute training with the 7th Special Forces Group and was a member of the XVIII Airborne Corps and 82d Airborne Division weather teams. Separating from active service, Major Fischer later became a distinguished graduate of Air Force Reserve Officer Training Center and was commissioned in 1984. From 1985 to 1989, he was a Minuteman II launch officer with the 12th Strategic Missile Squadron at Malmstrom Air Force Base, Montana. Missile crew duty culminated with personal appointment as the squadron command post flight commander and unit recognition as the 1988 outstanding missile squadron in Strategic Air Command. After an Air Force Institute of Technology school assignment, Major Fischer served on the faculty of the US Air Force Academy where he taught military, world, and American history. During this period, he was a visiting research associate at the Smithsonian Institution's National Museum of National History. Major Fischer then served as senior watch officer and air analysis section chief during a two-year tour of duty in the Republic of Korea/United States Combined Force Command Intelligence Operations Center in Seoul before beginning his current assignment in 1996. He earned an associate in applied science degree in weather technology from the Community College of the Air Force, a bachelor of science in natural resources from the Ohio State University, a bachelor of arts in history from the College of Great Falls, Montana, and a master of arts in American history from the University of Georgia. Major Fischer is a graduate of Squadron Officer School and Air Command and Staff College and is the author of more

than 40 articles, encyclopedia entries, and reviews for the *Dictionary of American Biography*, *Air Power History*, and the *Journal of Interdisciplinary History*, among others. He has presented papers at several conferences, including the annual meeting of the Canadian Historical Association. This is his first monograph. He and his wife Margaret are the proud parents of three children, Henry, Molly, and Nicholas.

Preface

This study examines the development of military night aviation from its origins through the First World War. Emphasis is on the evolution of night flying in those countries which fought on the Western Front, namely France, Germany, Great Britain, and the United States. While night flying occurred in other theaters, the most intense air effort was clearly in the west. There, belligerents pressed aviation technology and tactics to the limits; the skies of northern France and Flanders offered the only opportunity for movement across the stagnated front. Another important consideration was the availability of rich documentation concerning night aerial activity in the theater.

To appreciate the rapid development of night military aviation during the First World War, one first needs to understand the state of night flying prior to August 1914. Numerous aeronautical journals of the period offer articles exploring the technical problems associated with night flight. Additionally the *New York Times* provides a useful but more general day-to-day account of the evolution of flying during darkness. Source material for the war period is quite extensive.

Aviators' memoirs provide a personal glimpse into the trials and tribulations of night flying under hostile conditions. Contemporary journals contain numerous articles dealing with developments in the field. Yet archival materials offer the most wide-ranging information on the evolution of military night aviation.

The National Archives has an extensive assortment of World War I era United States Air Service documents embodied in Record Groups (RG) 18 and 120. However finding night aviation materials among the holdings is a rather time-consuming proposition. Within RG 120 is a collection of documents known as *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919.* Col Edgar S. Gorrell directed the assembling of data on all aspects of Air

Service experience during the First World War. Only a small portion of the 282 volumes of material was ever published due to military budget reductions in the 1920s.

The United States Air Force maintains its archives at the Air Force Historical Research Center, Maxwell Air Force Base, Alabama. While World War I night aviation information is limited, it is nonetheless accessible. Similarly, the French Service Historique de l'Armée de l'Air maintains numerous documents dealing with aviation *de nuit* during the First World War. The official French air service correspondence is especially useful for understanding the difficulties of early night aerial combat operations and training. Materials maintained at the British Public Records Office and in German archives would have further enhanced this study. Unfortunately, they remained beyond my reach.

Acknowledgments

As with any undertaking of such proportion and consequence, this study is the result of input, assistance, and direction by a host of people. Professors Roger P. Snow and William J. Furdell of the University of Great Falls (Montana) supported my goal of a graduate degree in history through instruction at the undergraduate level. Col Carl W. Reddel, Lt Col Mark Clodfelter, and the staff at the United States Air Force Academy Department of History believed in my abilities as an historian and provided sponsorship to attend graduate school. Hopefully this study does not disappoint them. An unexpected bonus with my academy teaching assignment was the warm friendship and wise counsel of then visiting professor Dennis E. Showalter.

The support provided on numerous visits to the United States Air Force Historical Research Center was most appreciated; a special thanks to Col (Retired) Elliot V. Converse III, former commander, and Dr. Richard Morse for their assistance. Gen Lucien Robineau, former director of the Service Historique de l'Armée de l'Air, kindly provided French archive material which greatly broadened the scope of this study. Tom D. Crouch and Karl Scheide of the National Air and Space Museum provided keen insight on the challenges faced by period aviation. Col George Williams, former deputy Air Force historian, became a strong supporter in getting this work published. Our mutual interest in Great War aviation made for stimulating conversation.

At the University of Georgia, the interlibrary loan staff performed yeoman work in fulfilling my endless requests. Professor John H. Morrow Jr. and Professor James Colvert (who was Professor Emeritus when he sat on my reading committee) graciously took time from their busy schedules to review and comment on the study as part of my reading committee. Most of all I owe a great debt to Professor (now Emeritus) Lee Kennett for agreeing to be my major professor. His direction and guidance sustained me through the many

travails of research and writing. Unfortunately all I can offer in return for the many hours spent on this project is a most heartfelt thanks.

And through it all, my wife Margaret's patience and unbending support enabled me to complete this study on a very tight schedule all the while grappling with the demands incumbent with three gregarious and loving preschoolers under foot. Her unselfish devotion as spouse and mother is hereby publicly recognized and ever appreciated.

Chapter 1

Night Aeronautics to August 1914

The earliest aeronauts to venture into the darkened sky did so by means of balloons. While possibly not the first documented case of a free balloon aloft at night, the ascent from London of Charles Green, Monck Mason, and Robert Holland in the balloon *Royal Vauxhall*, on 7 November 1836, is nevertheless epic. Boldly crossing the English Channel in fading twilight, the aeronauts were soon welcomed by the lights of Calais, France. Liege, Belgium, was easily recognized by the flames from its many furnaces. For most of the night, Mason commented in his book, *Aeronautica,* that "we could scarcely avoid the impression that we were cleaving our way through a mass of black marble." After sailing through the moonless night, the balloon finally descended near Nassau, Germany, after traveling 500 miles.[1]

That free ballooning distance record stood until John Wise and three other aeronauts embarked from St. Louis, Missouri, on 1 July 1859. Their ascent in the balloon *Atlantic* was in anticipation of a future transatlantic voyage. The flight ended the following day in Henderson Township, Jefferson County, New York, 800 miles distant. Though coming dangerously close to ditching in Lake Erie, Wise and John La Mountain, who also took part in the epic journey, remained riveted to the goal of crossing the Atlantic by balloon. Both men continued to experiment with endurance ascensions. Wise would finally meet his end in Lake Michigan during the night of 28–29 September 1879 on his 463d ascent.[2]

Also in 1859, Thaddeus S. C. Lowe, a rival of Wise and La Mountain, built the *City of New York* specifically for a transatlantic voyage. Unfortunately the balloon, rechristened *Great Western*, burst on 8 September 1860. While Lowe's transatlantic ambitions never came to fruition, he nevertheless achieved notable success with balloons during the American Civil War.[3]

Lowe apparently made history in August and September 1861 by making the earliest recorded captive balloon night

French Army Balloon

ascensions for military purposes. His mission was to count Confederate campfires. La Mountain made numerous free balloon flights over enemy lines for the Union army, but the honor of the first military free balloon night flight appears to belong to Capt John R. Bryan, serving for the Confederate States of America under Gen Joseph E. Johnston in eastern Virginia. In mid-April 1862, Bryan, on his first captive balloon ascension, soon found his cable cut. Drifting back and forth across the lines during the night, the captain was much relieved when he finally landed back on the Confederate side. Unfortunately, American military ballooning ended before termination of the war.[4]

Night ballooning stirred the imagination of those who ascended into the starlit sky. Part of the enjoyment clearly resulted from the stable atmospheric conditions often encountered at night. Such stability made the aeronaut's job easy, as Eugène Godard demonstrated on a night ascension when he "passed from one point of Paris and its environs to another, picking up his passengers." During the Franco-Prussian War, a besieged Paris kept in contact with the outside world by means of free balloons. Sixty-six balloons left Paris between 23 September 1870 and the armistice four months later. The hazards of passing over enemy troops during daylight soon resulted in numerous night ascensions from the city. Carried in the balloons were 1.5 million letters—the first overnight airmail service.[5]

European military balloon experimentation increased greatly after the Franco-Prussian War, with the British, French, and German armies all evaluating balloon use by the mid-1880s. The United States Army lagged behind, obtaining its first balloon in 1893. These military balloon branches were clearly the forerunners of twentieth-century military aviation.[6]

A great revival in free ballooning occurred in the United States after the record-setting ascension of Count de la Vaux during the Paris International Exposition of 1900. Cheered during departure by a crowd estimated at one million strong, the count remained airborne for more than 35 hours, finally coming to earth near Kiev, Ukraine. The flight covered a distance of 1,193 miles, surpassing Wise's 1859 journey.[7]

Aeronautics Clubs

Aeronautics clubs and contests grew rapidly in the first decade of the new century. The first club in the United States, the Aero Club of America, was founded in 1905 and was modeled after European organizations. Safer and more accessible than heavier-than-air flying machines and less costly and more easily maintained than dirigible balloons, the free spherical balloon proved to be a satisfying airborne medium. Free balloon experiences furthered support for military aeronautical developments.[8]

The first international balloon race, the James Gordon Bennett Coupe Internationale des Aéronautes, was held in Paris under the auspices of the Fédération Aeronautique Internationale (FAI) on 1 October 1906. The balloon achieving the furthest distance from the ascension point would be declared the winner (see table 1). With much foresight, the FAI had selected for the competition a day whose night would be brightly lit with moonlight and was known through meteorological records to routinely have prevailing westerly winds. Such conditions were supposed to assist the aeronauts in making long flights, but ultimately

Table 1

Bennett Cup International Balloon Races to 1913

Year	Location	Winner	Distance (Miles)
1906	Paris	Frank P. Lahm	402.4
1907	St. Louis	Oscar Erbslöh	872.5
1908	Berlin	M. Schaeck	808
1909	Zurich	Edgar W. Mix	696.5
1910	St. Louis	Alan R. Hawley	1,172.9
1911	Kansas City	Hans Gericke	468
1912	Stuttgart	Maurice Bienaimé	1,364
1913	Paris	Ralph H. Upson	383.2

Source: Adapted from Tom D. Crouch, *The Eagle Aloft: Two Centuries of the Balloon in America* (Washington, D.C.: Smithsonian Institution Press, 1983), chap. 17.

did not. Lt Frank P. Lahm of the US Army Signal Corps won the competition with a flight of barely 400 miles. Unfavorable winds forced Lahm to cross the English Channel, then land before being swept out over the North Sea.[9]

With the amazing growth of aeronautics clubs, concern for safety likewise increased. By 1909 the FAI established criteria for the award of a spherical balloon pilot license, one night ascension being part of the requirements. While licensing was not enforceable, earning one gave the aeronaut public credibility (see table 2).[10]

Table 2

Spherical Balloon Pilot Requirements, 1909 and 1911

1909

The applicant must

- be 21 years of age, and
- make 10 ascensions—one at night, one alone, and two conducted by the applicant under supervision of licensed pilots (with no interference) who report on handling to board.

1911

Applicant must pass the following tests:

- five ascensions without any conditions,
- an ascension of one hour's minimum duration undertaken by the candidate alone, and
- a night ascension of two hours' minimum duration, completed between the setting and the rising of the sun.

The issue of a certificate is always discretionary.

Source: Juliette A. Hennessy, *The United States Army Air Arm, April 1961 to April 1917* (Washington, D.C.: Government Printing Office, 1958), 218.

The broad appeal of these early organizations can be seen in the composition of America's third club, the Philadelphia Aeronautical Recreation Society (PARS). Organized in the latter half of 1906, the PARS prohibited "professionals" from membership, yet eagerly welcomed women, who made up roughly one-third of the organization by mid-1908. Therefore,

it is not surprising that two society dames (M. E. Lockington and Minnie Appelbach) were the first women in the United States to make a night flight by balloon.[11]

Military Applications

"Free balloons [were] of little practical use in the service." However, as few people had flown an airplane by the end of 1907, ballooning provided the military with an outlet for expanding aeronautical experience.[12]

Free ballooning enabled an aviator candidate to "acquire familiarity with dangling his toes in space." Lt J. N. Fletcher of the Royal Flying Corps (RFC), believed that airplane pilots and observers who had first plied the skies in a balloon would have greater confidence in their ability to fly heavier-than-air craft. Additionally, he contended that if Great Britain's balloonists were better organized, and had a central registry to collect meteorological information obtained during balloon ascents, night flying by airplanes would in five years be as safe as navigating on the sea. As early as 1909, Fletcher expressed the opinion held in British military circles concerning the high vulnerability of airships in combat and the need for operating under cover of darkness. The lieutenant had his own idea for training pilots. "If night flying is to be a principal role of airships," Fletcher insisted that, "the pilot must be trained first in night ballooning. When real flying, away from illuminated aerodromes, becomes a possibility for aeroplanes, some regulation should be adopted to make each pilot do at least two night balloon runs before he attempts to cross unknown country by night."[13]

Even after the Airship Company of the Air Battalion (formed in April 1911 to consolidate British military aviation) had become No. 1 Squadron, RFC, in 1912, free balloons were used for "reconnaissance training of aeroplane pilots when aeroplanes were in short supply." Barely a month after the First World War started, a Royal Naval Air Service (RNAS) pilot trainee wrote home about a night ascension in a free balloon from Hendon. He had not expected that flight training "should come down to an old (1902) gas bag."[14]

Once war production geared up and airplanes became more numerous, free balloon training of airplane pilot candidates declined. However, both the British and German armies did instruct captive balloon observers in the art of free ballooning. Such training prepared the observer to safely land a runaway captive balloon—witness Captain Bryan's Civil War experience. The British also used such vessels for reconnaissance and bombing training during the last decade of the nineteenth century. In the United States Army, free balloons were used for training airship pilots well into the postwar years, presumably with requisite night ascensions.[15]

There is little doubt that the steady improvements in airship and airplane performance in the decade prior to 1914 redirected military emphasis away from ballooning. The French army disbanded its captive balloon companies by 1911 in favor of dirigibles, while at the same time in Britain "the spherical balloon was drifting into obsolescence without anything comparable replacing it."[16]

The United States Army recognized the military operational value of free balloons as being "of little use" for anything but conveying information from a besieged position—apparently the lessons of 1870 Paris were not completely lost. Only Germany continued to actively experiment with balloons, having earlier developed the captive *Drachen*, often referred to as a "sausage" because of its shape, which could remain aloft in high wind conditions.[17]

Airship Development

During the first decade of the twentieth century, airship development caught the attention of the military. Whether nonrigid, semirigid, or rigid, the airship seemed destined for success. Its capacity for better stability than nascent airplanes, great lifting power, ability to remain aloft for lengthy periods, and the awe inspiring sight of the massive vessels aloft made the airship a likely candidate for military consideration.

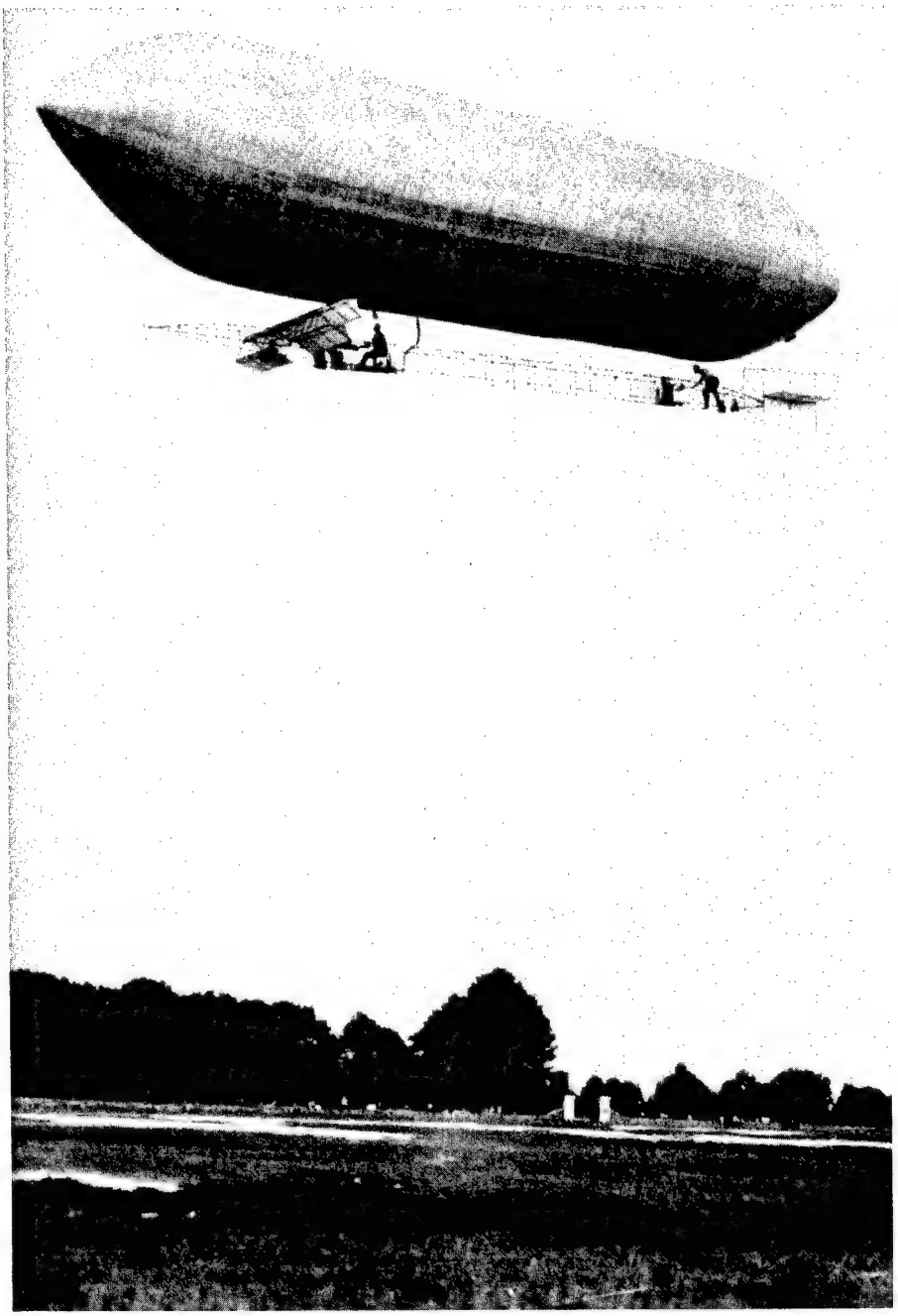
The nonrigid *La France*, built by Capt Charles Renard and Lt Arthur Krebs, became the archetype for the new class of air vessel. First flown on 9 August 1884, *La France* made seven demonstration flights. These French exhibitions convinced at

least one man of the military possibilities for such a vehicle. Fueled by patriotic fervor, Count Ferdinand von Zeppelin worked with an undivided devotion on rigid airship development. Sixteen years after the *La France,* the LZ1 (Luitschiff Zeppelin 1) made its maiden voyage on Lake Constance. While not an unqualified success, the LZ1 ushered in a new era in military aeronautics.[18]

The French army was the first to incorporate a dirigible, *Le Jaune,* into its inventory in 1905. The German army added its first airships of semirigid design in 1906–7 and commissioned a nonrigid airship in August 1908. Since the German military was thinking of the airship in regard to tactical operations as with an observation balloon, it is not surprising that they had no interest in rigid airships until the LZ3 made an eight-hour flight in 1907. The army then agreed to buy one from Zeppelin provided it could fly continuously for 24 hours and demonstrate its ability to navigate. Rather than give up against such outrageous demands, the count continued his difficult work.[19]

Because of the early experimentation with dirigible airships on the Continent, the British Committee on Military Ballooning recommended that the British balloon factory begin immediate research. The semirigid *Nulli Secundus* became operational in 1907. Across the ocean, the exhibitions of Thomas Baldwin, America's most famous prewar airship pilot, caught the attention of the US Army, whose Signal Corps Dirigible No. 1 would be supplied by Baldwin in 1908. Within a decade of LZl's first flight, the military in Europe and the United States made a commitment to dirigibles. Expectations varied widely among the nations, but the myth of British home isle impregnability lay shattered by the remarkable flights of Zeppelin's rigid airships.[20]

Volatile hydrogen and fragile envelopes made dirigibles an inviting target. The need for airships to develop operational night capabilities to overcome such vulnerabilities was clearly evident. On the evening of 17 August 1908, a dirigible ascended from Tegel, Germany, the location of German military ballooning headquarters, and rumors abounded that the trip was simulating anticipated wartime conditions. A month later, Major Gross, the commander of the Luftschiffer



Signal Corps Dirigible

Bataillon, made a 13-hour flight in a semirigid airship, most likely Militärluftschiff 1 (M1). Winds aloft increased well above 25 miles per hour, bringing the ship to "a stand-still for two hours over the village of Rathenow." Also during this period, German naval officials began to express confidence in the ability of airships to carry out strategic reconnaissance at sea. The fear of blockade was already apparent.[21]

Col J. E. Capper, superintendent of the British balloon factory, believed that two categories of airships were suitable for military use. One class would be comparatively harmless dirigibles of 70,000 to 100,000 cubic feet capacity, useful for scouting and tactical bombardment activities including night attacks on enemy bivouac areas. He posited that only during darkness might a dirigible "descend with safety to within a few hundred feet of the ground. . . . Even on a bright moonlight night it is difficult to see a balloon at 500 feet." Such an idea might well have been feasible in 1908 when there were no airplane or heavy antiaircraft defenses, but such a low-flying target at the outbreak of the war would have brought new meaning to the words "sitting duck."[22]

Capper's second class of airships were large, between 500,000 and 1,000,000 cubic feet capacity, and in his opinion, "may revolutionize the strategy of war." Their targets were to be such strategic targets as dockyards, arsenals, storehouses, and railway centers. Descending under cover of darkness, the airships could bomb their targets then escape the blast by using extended-delay fuses. Finally, he regarded the possibility of enemy invasion of Great Britain by airships to be "chimerical." On the contrary, Capper opined that a strong home fleet of airships was essential to prevent seaborne incursions from succeeding. While he undoubtedly bore a lot of grief from the Royal Navy for his remark, copies of Colonel Capper's address were eagerly acquired by the US Signal Corps.[23]

It should not be surprising, therefore, that several months later Maj George Squier, in an address before the American Society of Mechanical Engineers, defined the role of airships in a very similar manner. Having only recently acquired Signal Corps Dirigible No. 1, Squier readily incorporated the ideas of someone more experienced in airship strategy.[24]

Problems continued to mount for Count von Zeppelin, with weather, engine trouble, and accidents preventing his rigid airships from successfully flying for 24 continuous hours. Obviously, such endurance attempts required night flying during some portion of the test. Notably in one instance, during a planned long-distance journey from Friedrichshafen to Munich, Germany, several cities and towns along the route were "brilliantly lighted with electricity" to serve as navigational aids for the airship.[25]

Finally on 29 May 1909, when Zeppelin lifted off from Friedrichshafen on what was to be his first successful attempt to best the 24-hour mark, local residents thought little of the unannounced ascension, having already become "accustomed to night flights." The expedition ended 37 hours and 700 miles later.[26]

No doubt caught up in the emotion of Zeppelin's success, Gen James N. Allen, the US Army's chief signal officer, insisted that he favored the rigid airship over the airplane for military purposes, although the Signal Corps had but one dirigible in its inventory. Immediately, the War Department requested plans for the aerial defense of the east coast of the United States. One proposal divided the coast into a string of 250 mile-long ellipses with an airship station housing two to three dirigibles to be located in the center of each ellipse and a searchlight network for night patrol navigational aids. With greater perception than exhibited by the United States military, the *New York Times* called Zeppelin's journey a great feat, but nevertheless one that "will not convince those persons who have most closely studied modern aeronautics that the dirigible balloon is to be the flying machine of the future."[27]

Military Trials of Airships

In Great Britain as early as March 1909, many English citizens, living mainly in the eastern counties, had begun to hear "phantom" airships at night. Ostensibly, the increasingly aggressive posture of Germany, in concert with Zeppelin's endurance records, Blériot's crossing of the channel in an airplane, and the inability of British naval and military forces to offer protection against aerial invasion, brought many

British citizens to the realization that their island fortress was no longer impregnable. Combining that fear with the image of destruction wrought against New York City and elsewhere by a German air armada in H. G. Wells' *The War in the Air*, led to a sort of Zeppelin hysteria during the spring of 1909. Wells called forth a vision of warfare where old methods of limiting destruction were ineffective and resulted in social disorganization. Little wonder so many people were hearing a new bogeyman in the night.[28]

With regard to fiction, a more tranquil account of airship development was offered by Rudyard Kipling, in a book that came out during the year of the phantoms. Set in the year 2000 A.D., *With The Night Mail* envisioned a worldwide system of postal packet airships, plying the night skies along designated air routes. Other commerce carriers similarly dotted the skies, while large freighter submarines hauled cargo through the ocean depths. Perhaps Kipling's vision of peaceful employment of the new warfaring technology manifest in airships and submarines helped settle the British hysteria of 1909. For better or worse, such writings undoubtedly kept the public interested in aeronautical developments.

Airships were nevertheless soon involved in night military operations and training. On 3 November 1909 three German airships, the M2, P2, and Z2 (formerly LZ5), departed Cologne, Germany, under cover of darkness to execute mock attacks against the garrison at Coblenz and the fortress of Ehrenbreitstein.

Londoners truly did hear an airship in the early morning hours of 3 June 1910. The *Beta* flew a 70-mile round trip from the balloon factory at Aldershot, England, circling Saint Paul's Cathedral from 1,000 feet.

French airships and airplanes participated for the first time during the 1910 army maneuvers. In the process a Clément-Bayard dirigible successfully reconnoitered the positions of bivouacked armies at night.[29]

Once again, rumors of German airships flying over England were sounded. According to the *New York Times*, a dirigible was plainly observed by members of the RFC over Scheerness, a garrison town and naval seaport, on the night of 14 October

1912. The new German naval airship, L1 had indeed left Friedrichshafen the previous day on an endurance flight that lasted 30 hours and covered 900 miles, but the Germans steadfastly denied such an intrusion. Certainly this disavowal met with skepticism, but in the end the importance of the "scare" was that "Germans were capable of such a foray and there was nothing the British could do about it."[30]

Night airship experimentation increased as airship capabilities improved. The British made at least one attempt with the *Beta* in 1913 for night artillery spotting. In the last days of peace, Germany's L3 made a 22-hour endurance flight during which experiments in radio direction finding were presumably conducted. Convinced that airplane development remained in an immature state, German war planners recognized the utility of night operations but insisted that their airship fleet was intended mainly for daylight operations. Nevertheless night airship flights had become almost routine for the British, French, and Germans on the eve of Sarajevo.[31]

As hostilities opened in August 1914, the combatants were clearly unequal in airship strength and ability. The Germans had 12 airships available—10 rigid and one each nonrigid and semirigid. France could muster only six dirigibles, many having previously become obsolete. The first French rigid ship was unavailable, needing further modifications. In Britain all army airship assets had previously been transferred to the navy. Only seven nonrigid and semirigid airships were available. In fact building of the first rigid-designed ship had not even begun by this time, "those valuable years from July 1908 had been frittered away."[32]

Airplane Night Flying

Understandably, the development of night flying by airplanes was a slow process. Unable to fly in the slightest bad weather, fragile early craft could scarcely be expected to venture into the nighttime sky with any degree of safety. The first recorded night flight occurred on 22 October 1909 at College Park, Maryland, though others may have taken place earlier. Wilbur Wright and his student, Lt Frederic E. Humphries, a Signal Corps aviator trainee, flew for 42

minutes "under a bright moonlight." Wright flew a two-minute night solo 10 days later. The only other recorded Wright brothers night flight took place at Hempstead, Long Island, New York, on 7 August 1911, with Orville flying a model R. Unfortunately, the Wrights failed to record their impressions or reasons for flying after darkness.[33]

Airplane night flying manifested itself for the first time in Europe on 28 April 1910, during *The Daily Mail*'s London to Manchester, England, race. Only five days earlier, Claude Grahame-White abandoned his first attempt at the $50,000 prize, "recognizing the danger of approaching Manchester in the darkness." On this attempt, Grahame-White had competition for the purse from Louis Paulhan, a French airman. The French pilot landed in the dark near the village of Lichfield, having run out of fuel after covering 117 miles. Well behind Paulhan, Grahame-White descended near the village of Roade (in the vicinity of Northampton, England) since "the light was getting too bad."[34]

In an unsuccessful bid to overtake his rival, Grahame-White decided to leave the ground in the early morning hours, but not until the moon had risen. The fear of losing the $50,000 prize no doubt influenced his decision to fly in the dark. Commenting on his harrowing experience the following day, Grahame-White recalled that,

> I felt—well, I scarcely know how I felt. I did not know whether I should lose myself flying through the night. My start was a confused jumble of scattered lights, which swept away swiftly below me. I could not judge my run along the ground, but I rose as speedily as possible. Directly I was in the air, the lights of the railway station showed clearly below me, and I headed for them. I could see absolutely nothing of the ground below me; it was all a black smudge. . . . Great difficulty presented itself in knowing in the darkness whether I was ascending or not. I had done no night flying before.[35]

The British, while giving Paulhan credit for winning the race, lauded the night flying of Grahame-White even more. One journalist who witnessed the event "saw him pass overhead like a great black bat." Apparently the loss of a second coveted air record to a Frenchman, the first being Blériot's channel crossing in 1909, injured the pride of many British. Hence they extolled Grahame-White's accom-

plishments at the expense of Paulhan's victory. Being a bit more objective, the *New York Times* cautiously noted that night flying "will have to receive much consideration from the navigators of the future, and the problems they will have to solve are many."[36]

Nonetheless, sailing through the night sky caught the imagination of many pioneer heavier-than-air aviators, just as it had with balloon and airship aeronauts. Exhibition pilots began to add night flights to their repertoire before the end of 1910. Charles K. Hamilton, one of America's premiere stunt pilots, amused himself by chasing a bat during one night flight. Ralph Johnstone and Walter Brookins flew by moonlight for over an hour. Arch Hoxsey went so far as to cover his aircraft with metallic aluminum paint. Ascending into the nocturnal sky, his aircraft "became as bright under the silver of the moonbeams as if it had been phosphorescent."[37] However, such folly had its consequences. Accidents were commonplace for exhibition pilots during the day, and night only compounded the dangers involved in stunt flying. At a meet in New Jersey, several Wright exhibition team members ascended into the darkness, equipped with port and starboard lights, as well as automobile horns to "honk each other out of the way." By 1912 so many of these pilots had been killed or injured in trick flying that Brookins, a well-known daredevil, formed the "Safe and Sane Club," in which pilots pledged not to stunt. Howard Gill, who had been seriously injured while attempting a night landing, joined the club. However, as the American public's demand for stunt flying remained insatiable, it was not surprising when Gill was killed in a twilight midair collision during an exhibition in Chicago.[38]

The first organized night flying exhibition in Great Britain occurred around this time. Grahame-White and Louis Noel flew as part of a pyrotechnic display at Hendon, England. Their airplanes were equipped with multicolored electric light bulbs. Léon Morane made night flights in a Blériot monoplane from Etampes aviation camp in France in August 1910. Other French pilots soon followed his example.[39]

Through 1912, with the exception of the London to Manchester race, flying remained limited to the immediate

confines of the aerodrome and at low altitudes. Such restrictions, besides the obvious need to stay within range of the paying multitudes at flying exhibitions, appear to have been dictated by the unreliability of aircraft engines. While such flying was sure to please a crowd, one author felt assured that "in reality they were easy and hardly dangerous." Whether or not he had flown at night during this period is unknown. In the United States exhibition flying became bolder, with night loop-the-loops the crowd pleaser of 1916 (fig. 1).[40]

With improvements in aircraft capabilities, more and more pilots began attempting long-distance and endurance flights. The Frenchmen Ernest F. Gaillaux and Maurice Gaillaux made long-distance flights from Biarritz, France, during 1913. But the exploits of two German pilots, Bruno Langer and Karl Ingold, early the following year remain phenomenal accomplishments even today.[41]

On 3 February 1914, Langer flew an incredible 14 hours and seven minutes nonstop, setting a new duration record. Not to be outdone, Ingold departed Mulhouse in Alsace, four days later for a long-distance flight. Flying near the Allgau mountains in the dark, he "perceived on the horizon a light which drew him like a moth"—Munich. Ingold landed his Aviatik biplane there after flying 16 hours and 20 minutes and covering 1,700 kilometers. Langer quickly reciprocated with another attempt on 11 February, leaving Johannistal aerodrome in a Roland biplane loaded with 655 liters of gas and 60 liters of oil. On landing at Kreuz near Posen, Langer was only 20 minutes short of tying the record.[42]

The journal, *l'Aérophile*, argued that the robust nature of German aircraft, with their water-cooled engines, inspired "absolute confidence" in their pilots. Many German fliers therefore became determined to "systematically practice night flights" in the hopes of winning the large prizes offered by the *National Flugspende* (National Aviation Fund). Without the excessive fear of mechanical failure, and with the innovations in airborne and ground lightning systems, which are discussed later, the Germans led in the attack for the conquest of the night.[43]

Miss Katherine Stinson writing the abbreviation "Cal" by a series of eight loops at Los Angeles.

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Figure 1. Flying School Advertisement from 1916 Showing Night Looping Exhibition

Military Night Flying

Organized military night flying was slow to germinate in the prewar period. Simply stated, the operational usefulness of such flights was not foreseen. In fact, the RFC specifically prohibited night flying in its original standing orders of April 1912, as did various French regulations as late as 1913. Even so, the boldness of many early aviators dictated night experimentation. Maj Wilhelm Siegert established German military night flying experimentation at Metz, in the winter and spring of 1913. He would remain a driving force for German night activity during the First World War.[44]

The first RFC military wing night flight occurred on 16 April 1913, when Lieutenant Cholmondeley flew a round trip from Larkhill to Upavon. No. 3 Squadron made further pilgrimages into the night, but organized, meaningful night training before August 1914 was resisted by higher authority—the only mission of the military aviation wing remained daylight reconnaissance. Speaking at a meeting of the Aeronautical Society of Great Britain in February 1913, Maj Frederick H. Sykes, commander of the military wing, RFC, argued against too much reliance on airplanes, in part due to their limitations in night work. Yet, he foresaw an increasing likelihood that ground armies would mask their movements in darkness, owing to the daylight presence of observation aircraft. He believed that night reconnaissance might become "one of the most important duties of aircraft."[45]

Sykes spoke again to the Aeronautical Society the following year. While progress was being made, he declared,

> To sum up the question of observation, although a very solid all-round advance has been made in day work, night work, in so far as the aeroplane is concerned, has shown no tangible results. Night work at present lies in the scope for the aeroplane which can, for certain, fly for 14 hours with two engines and fuel for this endurance.[46]

Motors remained unreliable and undercarriages not strong enough to withstand hard landings while inadequate lighting further hampered night operations.

As already mentioned, a US Army Signal Corps officer accompanied Wilbur Wright on the first night flight in 1909. Apparently, nearly two years transpired before night flying

reappeared at the aviation field at College Park, Maryland. Lieutenants Thomas DeW. Milling and R. C. Kirtland landed by signal fires after a short flight from Chevy Chase on 21 August 1911. Similarly, Capt Charles DeF. Chandler, the field commander, returned from the Naval Academy one summer night in 1912 to land by beacon fire. He had followed the signal lights along the Baltimore and Ohio Railway line to College Park. In November 1911, night scouting was attempted at the field using two airplanes equipped with acetylene searchlights. Lt Henry "Hap" Arnold flew on one of these experimental aircraft, yet two years later declared that "the use of aeroplanes at night need not be considered at the present time, even if there are fanciful pictures of aeroplanes fitted with searchlights."[47]

Interestingly, an article appeared in the Austrian journal *Fachzeitung für Fluptechnik* immediately after the US night scouting experiments of 1911, extolling such efforts. Trials of airplane-mounted spotlights, while not completely successful, nevertheless had shown that night reconnaissance might become an important future function of airplanes. With remarkable insight, the author of the article even posited the idea of night photographic reconnaissance. If airmen used sensitive cameras in conjunction with airborne searchlights, the darkness would no longer hide enemy activity. During the French army maneuvers of 1912, a squadron of 15 airplanes was equipped with searchlights, presumably for night observation activities. Yet few aviators were convinced of the value of night airplane reconnaissance in the prewar era. Such a scheme would not find useful implementation until the closing months of the First World War.[48]

US Signal Corps night activity remained unorganized until Europe had been at war for quite some time. United States Naval Aviation, established in July 1911, similarly incorporated experimental night flights before the war. The Belgian M. V. De Jonckheere performed a mock night attack on the USS *Massachusetts* docked at Philadelphia in 1912. Searchlights attempted to illuminate his plane before it reached the ship. He contended that he "could have blown the warship to atoms." On the opposite coast, naval officers had earlier watched a similar attack as well as a mock bombing of a

miniature city by several civilian aviators, including Glenn Martin. Additionally, naval aviators flew night scouting missions at Guantanamo Bay, Cuba, finding the wind conditions more favorable than during the day.[49]

By 1914, though man had been roaming starlit skies for nearly a century, the conquest of the night had scarcely begun. The First World War would change all that as necessity spurred innovation in flying under the cover of darkness. Indeed, night flying could no longer be ignored.

Notes

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14. Mead, 42; Harold Rosher, *In the Royal Naval Air Service: Being the War Letters of the late Harold Rosher to his Family* (London: Chatto and Windus, 1916), 20–21.

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17. War Department, *Field Service Regulations, United States Army, 1914, corrected to 31 July 1918* (Washington, D.C.: GPO, 1918), changes nos. 1 to 11, extracted in Maurer Maurer, *The U.S. Air Service in World War I*, vol. 2 (Washington, D.C.: The Office of Air Force History, 1978), 23; Christienne and Lissarague, 26. The United States Army Signal Corps added a Siegsfeld drachen balloon to its roster in 1899, Crouch, 527.

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Chapter 2

The Emergence of Night Bombing, 1914–1916

Aerial bombardment was in its infancy as the First World War spread across Europe. Experimentation had taken place in the prewar era, most notably manifest in the Michelin bomb-dropping competitions, the Aéro Cible, which began in France in 1912. Germany had examined the possibility of the use of Zeppelins as bombing platforms, while in Great Britain, the Royal Naval Air Service actively pursued such activity with airplanes. The RFC did some experimentation but insisted that reconnaissance remained the primary function of aircraft. The Canadian official historian notes that there was much "visionary writing" about aerial bombardment yet there existed "little connection between theory and reality." By August 1914, the very idea of night aerial bombardment by airplanes was given little thought.[1]

Pilots began to carry small bombs in their aircraft during daylight scouting missions. The bombs were dropped into the massed troop formations encountered daily during the "war of movement." Though this aerial bombardment made little impact on the advance or retreat of troops, it caused short-term disruptions as soldiers took cover during the bombings. The primary purpose was to harass the ground forces. Nevertheless, aerial bombardment soon found sanction with higher authorities who wanted to strike the enemy by all possible means. Bombardment hence became a second specialized function of the military airplane, though it would remain in a primitive state of development for some time.[2]

French leaders were so impressed with the possibilities of aerial bombardment that they created Groupe de Bombardement (GB) 1 on 27 September 1914 after less than two months of combat. In October the Grand Quartier Général (GQG) ordered the formation of 16 bomber escadrilles to be organized under four GBs. The advancement of French bombardment aviation had begun. With grand designs of its own, the German air service formed the Brieftauben Abteilung

Ostende (BAO) to bombard England from Calais. Yet Russia made the most audacious attempt to acquire a bombardment capability for its air service by incorporating Igor Sikorsky's giant four-engine Ilya Murometes airplanes into the Squadron of Flying Ships.[3]

With the exception of Sikorsky's large aircraft, early bombardment planes were simply converted observation platforms with little capacity for carrying bombs. Often they were pusher aircraft (with the propeller situated behind the aviators pushing the plane through the air) which afforded excellent forward visibility. Tractor aircraft (propeller in the front), with their more restricted field of vision, were found less useful as early bombers. As one example, the French air service developed the Voisin pusher into its first bomber. With good visibility for the aircrew, the airplane apparently was selected because its bomb-lifting capacity exceeded that of any other airplane in the French inventory. With engine improvements and use as a night bomber, the Voisin remained active throughout the First World War.[4]

Prewar theorists of airpower regarded the airship with its great lifting capacity as the ideal instrument for aerial bombing. It is not surprising then, that a Zeppelin following quickly on the heels of the German infantry advance into Belgium carried out the first night bombing operation of the First World War. During the night of 6–7 August 1914, the German army's Z6 attacked the fortress of Liege. However, the airship was damaged by gunfire during the assault and subsequently removed from service. In the following weeks, three more German army airships were lost during low-level daylight operations.[5]

The long-feared German airship blitz had proven to be myth. Soon after these stunning losses, German military authorities restricted the remaining dirigibles of prewar construction to night use. Nevertheless in night operations against Antwerp, and Ostend, Belgium, during September, the airship confirmed its usefulness. Experience in night employment began to show that flights under bright moonlight were exceedingly hazardous for the slow-moving dirigibles. By November 1914 German craft were restricted to operating only on dark nights associated with the new moon.

Such a policy limited airship operations to a maximum of about 14 nights per month.[6]

The French fared little better with their airships in the early months of the war. While carrying out night missions, the French dirigibles *Conté* and *Dupuy de Lôme* suffered heavy damage from friendly fire. Influenced by preexisting fears of the German dirigibles, French troops saw in every airship the spectra of the "Zeppelin." Unable to stop their troops from indiscriminate firing, French authorities discontinued airship operations. Airship operations would not resume until April 1915. Once missions recommenced however, the French military found their airships increasingly vulnerable during night operations. By autumn, missions were carried out only on the darkest nights—a lesson the Germans had learned nearly a year earlier. Disregarding the risks, the airship *Alsace* continued to fly at low altitudes, even on moonlit nights, in the hope of improved bombing accuracy. Such daring turned to tragedy on 2 October 1915 when the dirigible was destroyed during a night operation.[7]

The First Night Aviators

During this time, the first bombing planes penetrated the nighttime sky. Several aviators claimed to be the first to undertake such a mission. Sous-Lieutenant Vincente Almandos Almonacid, commander of Escadrille MF 29 at the end of 1915, declared that he had made a trial night flight in September 1914. For this, he was punished by higher authorities. Ignoring his superiors, Almonacid made another night flight after which he "obtained authority to make raids and bombing on the North Sea coast." Unfortunately, no other source has corroborated his assertions, though they may well be fact.[8]

Another aviator who claimed the first night bombardment of the war was Wing Commander Charles Samson, commander of No. 3 Naval (N) Squadron, RNAS at Dunkirk.[9] Samson relates that while he was heading to the aerodome on the night of 27 January 1915 for his next night bombing mission, an unseen German machine bombed the airfield. Maj Wilhelm Siegert, the organizer of BAO, insists that the bombardment occurred the following evening. For this BAO operation, 14

mixed-type aircraft, including at least one Otto pusher—an "antediluvian machine"—departed one after the other from Ghistelles airfield. Siegert noted later that "every once in a while we saw below us or to our side the fiery exhaust lain gases of other airplanes." Amazingly there were no midair collisions during the mission and all aircraft returned home safely. Later, to reduce the possibility of collision, night bombers were individually dispatched at intervals of roughly five minutes.[10]

The BAO found itself stranded at Ghistelles airfield when the German offensive ground to a halt in northern France. Without a base at Calais, the unit could not carry out a protracted bombing campaign against England with existing aircraft. The BAO was sent to the Eastern Front for a time, only to return to Ghistelles airfield in early 1916.[11]

Within a month of Siegert's night bombardment mission against Dunkirk, a Friedrichshafen FF 29 floatplane assigned to the German Navy's Seeflieger Abteilung (Sfa) at Zeebrugge, made an unopposed night penetration 25 miles into England. After dropping three bombs which caused no effect, the plane made a forced landing in the channel. The crew was later rescued and interned by the British.[12]

Night Attacks

The FF 29's sortie had not been Germany's first night incursion over British soil. Several days earlier, on 19 January 1915, Navy Zeppelins L3 and L4 set off from Hamburg-Fuhlsbüttel, each carrying its maximum loads of 16 men, eight 110-pound explosive bombs, and 10 or 11 25-pound incendiaries to attack targets along the Humber River. Unable to reach their objective, the airships bombed targets of opportunity before turning for home. The mission demonstrated to German authorities the need for a more advanced base of operations before London could be attacked.[13]

Such was not a prerequisite for attacking Paris. The capital was assaulted on the night of 20 March 1915 by two German airships flying at 7,000 feet. Heavy antiaircraft fire crippled one dirigible as it passed over the city. Another raiding airship was damaged while attacking the French army headquarters

at Compiegne. Though Gen Ernst von Höppner, later the kommandierender general der Lufstreitkräfte, remembered the operation as a success, further similar "successes" would have decimated the German airship fleet. Additional night raids occurred in the first half of 1915 against Dunkirk, Nancy, and Calais.[14]

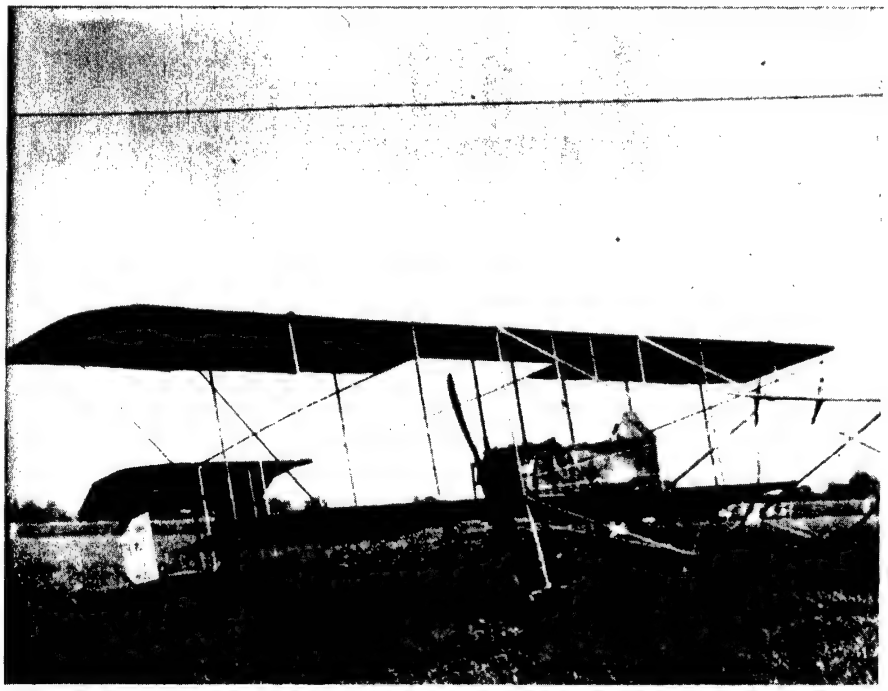
The Germans tried a novel method for navigating airship Z12 over Calais on the night of 17 March 1915. Due to poor visibility, the crew had been unable to locate their objective. Therefore a singly manned observation car was lowered from the airship's bomb compartment by means of a thick steel cable. Steering blindly by directions telephoned to the control car from the observer 1,000 feet below, Z12 was able to complete its bombing mission.[15]

Naval zeppelins carried out two more night attacks against England before the first appearance of a German army airship over the British Isles. The army's four-engine, one million-cubic-foot capacity LZ38 attacked East Anglia on the night of 29 April 1915. Little more than a month later, this same airship made the first night raid on London. Airship LZ38 flew five more missions over England before being destroyed on the ground by RNAS bombing.[16]

Bombardment Aircraft

Airships had easily adapted to a night bombardment role during the first year of fighting; such was not the case for existing limited capability airplanes. Converted observation aircraft would simply no longer suffice for aerial bombardment. Specialized aircraft specifically designed for such a role had become a necessity. One author believed 1915 was the "Year of Decision" for German aviation, and certainly that motto was fitting for other air services as well.[17]

The need for greater aircraft range was immediately evident with the failure of the BAO to implement cross-channel bombing from Ghistelles airfield. Another related problem was the lifting capacity of aircraft. The Maurich Farman (MF) 7 "Longhorn" and MF 11 "Shorthorn" are prime examples, neither type could carry more than 300 pounds of bombs. The



Farman Longhorn

answer to these challenges appeared in the development of multiengine bombers.[18]

Sikorsky had already demonstrated such a capability with his four-engined Ilya Muromets airplanes. Additionally, Giovanni Caproni's trimotor prototype was flying before the end of 1914. The belligerents pushed for multiengined development, two of the boldest schemes being the *Riesenflugzeug* (R-plane) and the British Handley Page 0/100 programs. Progress was slow as immense difficulties had to be overcome before prototypes became operational. Neither plane would play a role in Western Front aerial bombardment until late in the war.[19]

Ventures less ambitious than the Handley Page and R-plane programs were undertaken as short-term solutions for bombardment. One example was the German C-planes, armed, single-engine biplanes which, though devised for observation, became useful bombers in 1915. These aircraft continued to be used as bombing platforms through much of

the war. *Grossflugzeuge* (G-planes) were an outgrowth of the German failure to capture Calais. They were the first twin-engine aircraft of World War I, and quite possibly the first aircraft specifically designed for bombardment to go into large-scale production. However, they remained in insufficient numbers until 1917.[20]

Another critical challenge to the development of bomber aircraft in 1915, the Year of Decision, came from increasingly effective air and ground defenses. Antiaircraft artillery (AAA) had been practically nonexistent at the start of World War I. By the spring of 1915, Germany had 138 such weapons. Furthermore, the entry into the daytime skies of tractor monoplanes with fixed forward-firing machine guns spelled trouble for bombardment aviation. Bombers no longer had comparatively free passage to their objectives. Burdened by added weight, the bombers had little chance to outmaneuver the smaller, faster-flying, quicker-climbing fighters.[21]

The Morane–Saulnier Type N gave the Allies a great offensive advantage in the sky. Metal deflectors were attached to the propeller for protection against its forward-firing machine gun. Yet the first airplane specifically designed for aerial fighting was the Fokker Eindekker used by the Germans. It had the distinction of being the earliest airplane with a synchronizing gear to prevent bullets from striking the propeller. Pushers like the Voisin were vulnerable to attack by these airplanes since they had no defense against attacks from the rear. By the end of 1915 daylight bombardment aviation was sustaining heavy losses due to the combination of pursuit aircraft and antiaircraft artillery; the only immediate solution was to fly under the cover of darkness.[22]

Hazardous Aspects of Night Flying

In the increasingly high threat environment of 1916, night flying provided bombers with freedom of action on the Western Front. Few fighter pilots were willing to fly their unstable machines at night. The opportunity for intercepting bombers at night appeared insignificant. AAA was more inaccurate at night than during the day. Unless a plane was caught in a searchlight beam, AAA could offer only feeble resistance to the

unseen night fliers. Ranging remained difficult even when searchlights illuminated aircraft for short periods.

Another advantage for the bombers was that they could fly at lower altitudes than during daylight operations, increasing the likelihood of scoring direct hits against targets. Night bombing had a great effect on morale. What could be more terrifying than bombardment by an unseen enemy against whom there was no defense?

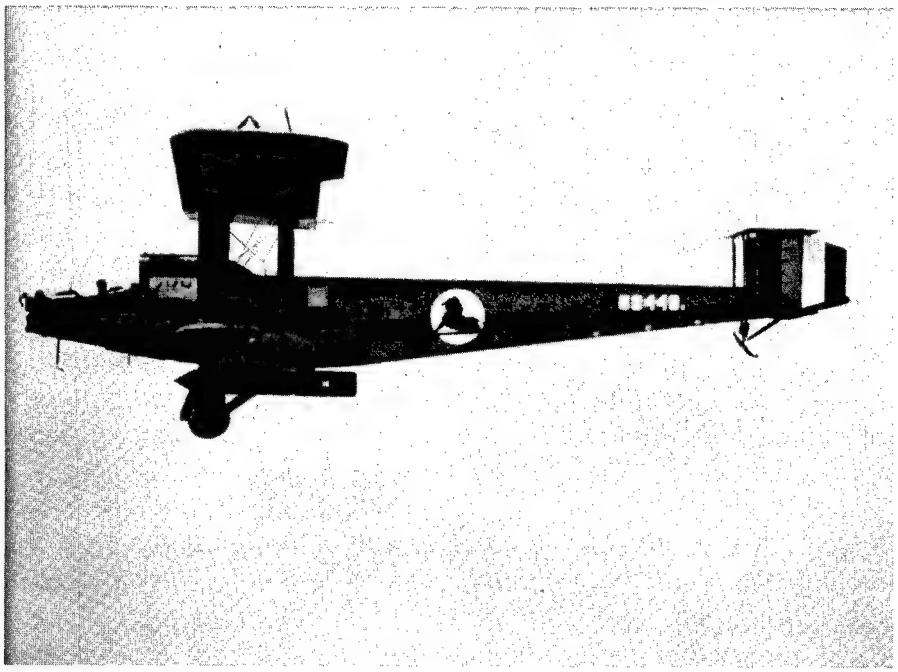
Yet there were a multitude of disadvantages to night bombardment. Navigating to the target area and distinguishing the target were especially difficult on dark nights or in bad weather. Some targets could not be seen. Therefore, only large, readily identifiable targets that could not be camouflaged, such as railway yards and cities, were suitable objectives. Since the enemy knew the probable targets for night bombers, elaborate ground defenses were soon established. Hence the fliers often had to dodge searchlights and shrapnel on their bombing runs, often with the consequence of decreased bombing accuracy.

Probably the most hazardous aspect of night flying was landing safely. Since fog or mist often obscured the ground at low altitudes, landings remained dangerous even after the advent of standardized airfield lighting in 1916. Additionally, forced landings because of motor failure were a persistent threat to plane and pilot.

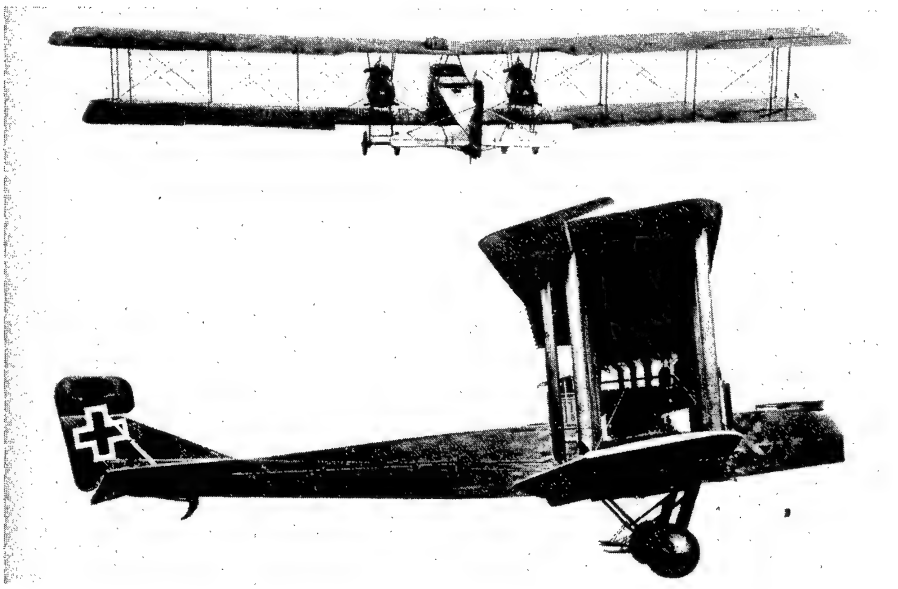
Differences in Day and Night Bombardment Aircraft

Part of the difficulty in night bombardment operations stemmed from the use of day bomber planes. Just as early bombers were limited because they had been designed for observation, there were disparate requirements for day and night bombardment aircraft. The Handley Page, Gotha, and Caproni dominated World War I strategic night bombardment, yet these planes had not been designed for night operations. Size and slowness limited them to night flights, where they performed admirably.

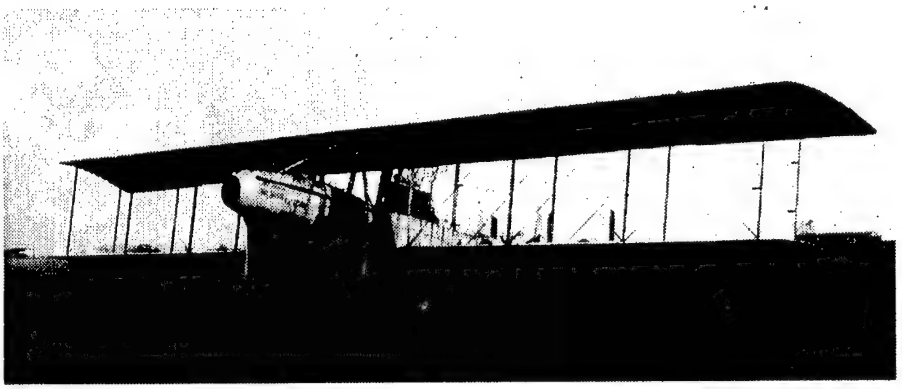
One of the first aviators to make a clear distinction between day and night craft was Wing Commander Samson of the



Handley-Page



Gotha



Caproni

RNAS. In a letter to the British Admiralty early in 1915, Samson argued that these requirements were necessary for a successful night bombing capability:

1. a reliable engine,
2. a speed of 70 miles per hour or more,
3. the capability to carry 300 pounds of bombs,
4. pusher biplanes, and
5. a silenced engine.[23]

These were modest requirements, clearly fulfilling tactical rather than strategic purposes. Though the introduction of fighter aircraft had made pusher aircraft obsolete for daytime use, the pusher's wide range of visibility made it useful at night. The concept remained in vogue throughout the war, even for strategic bombers. By means of multiengine design, the nose of such craft remained open, providing the requisite visibility for night operations.

The French put great stress on visual field. They claimed that German night bombing was no serious threat so long as the Germans used C-planes.

> The lack of progress in enemy night bombardment has been due to the type of airplane it used, with the motor in the front. Only exceptionally is it possible to do something worthwhile with this type of aircraft at night. You need a night with particularly good visibility, an easy route to follow, and objectives easy to find. . . . A full and unobstructed field of view, both front and straight down is the first requirement of a night aircraft. . . . No airplane with the motor in front can be a good plane for night use.[24]

The German *Nachtflugzeug* (N-plane) was the first aircraft particularly designed for night bombardment. With abnormally cambered wings capable of lifting heavy loads over short distances, the N-plane was a compromise between the C- an G-planes. The unusual wing configuration also yielded a shorter takeoff roll with obvious benefits for night flying. However, only about 200 of these airplanes were produced between 1916 and 1918, as aircrews preferred the proven abilities of the G-plane.[25]

Nighttime bombardment could never completely replace the day function however. Daylight bombing was favored over night employment simply because it could be carried out against a wider array of military targets. If the night bombers could not see the target, they could not bomb it. Many military leaders considered night bombardment's primary worth to be its nuisance value. Attacks on bivouacs disrupted sleep, and token raids on cities bred dissension among civilians. Night attacks on factory complexes and blast furnaces achieved little long-term effect due to their limited scale. Hence, military authorities pressed for establishment of credible daytime bombardment even as enemy defenses increased.[26]

Organizational Changes

In 1916, the increase in French night bombing activity coincided with organizational changes (see table 3). By 11 March 1916, GB 3 was officially recognized as the first French night-bombardment unit, and by May practically all French bombers flew under cover of darkness.

Even the new types of bombing aircraft added to the French inventory at this time—the Bréguet-Michelin (BM) IV, Caudron G-4, and Caproni—could not compete against the Fokker in daylight operations. They too were assigned to night bombing.[27]

German bombardment also underwent modification in late 1915–early 1916. BAO was redesignated Kampfgeschwader 1 der Obersten Heeresleitung, or Kagohl 1. In all, five kagohls were formed, each with six kampfstaffeln. The kampfstaffeln were individually equipped with six C-planes, the multi-purpose airplane type dominating the German air inventory by the end of 1916. Kagohls were used for tactical bombing

Table 3

Distribution of French Bombardment, 19 January 1916

Group	Location	Escadrilles	Assignment
GB 1	Malzeville	VB 101 VB 102 VB 103 VB 112 VB 114	GAE
GB 2	Malzeville	VB 104 VB 105 VB 106 N 65 C 66	GAE
GB 3	Breteuil	VB 107 VB 108 VB 109 VB 111	GAN
GB 4	Belfort	MF 29 C 61	GAE
	Luxeuil	MF 25? C ?	
GB 5	Ochey	BM ?	GAE
(Not formed until February 1916)			

Group d'Armée de l'Est (GAE) (Army Group of the East)

Group d'Armée du Nord (GAN) (Army Group of the North)

Source: Adapted from "ORDER NO. 1302, G.Q.G. DES ARMÉES DE L'EST," in *Les Armees Francaises Dans La Grande Guerre*, Tome 111, vol. 4e (Paris: s.n., 1926), 656, annex 3276, quoted in "Wind Soc," *Cross and Cockade Journal* (US) 12, no. 4 (Winter 1971): 380.

operations but could not be considered strictly bombardment units like the French GBs. When required, the kagohls performed daylight observation, escort, and defensive patrol work. With only 24 G-planes on active duty in late 1916, German aviation continued to lack a heavy-bombardment capability. However this situation was soon to change.[28]

In October 1916, increasing availability of aircraft enabled the German army air service to reorganize its force structure again. By then seven kagohls were in existence due to the boost in C-plane production. As the war dictated further specialization of aircraft duties, the Germans reduced the

number of kagohls to three (Kagohls 1, 2, and 4), which became bombardment units. Their bombers increasingly flew under cover of darkness. The excess kagohls performed such nonbombing missions as escort duty, formerly required of the bombardment squadrons.[29]

By early 1916, new units and aircraft joined the RNAS at Dunkirk, France. Sopwith 1½ Strutters and French-built Caudron G-4s joined Bréguets and Farmans in the RNAS bomber force. No. 1 (N) Squadron had been reorganized into a wing by the end of 1915. Several months later, the unit was joined at Dunkirk by No. 4 and No. 5 (N) wings. These units performed all types of airplane missions, including bombardment, which by this time was usually carried out at night. Additionally, RNAS plans called for No. 3 (N) Wing to be developed into a strategic bombardment force.[30]

Through 1915 the RFC stressed reconnaissance as its primary duty. However, apparently due in part to losses against the Fokker, Gen Douglas Haig, the British Expeditionary Force (BEF) commander, authorized night bombing of objectives "up to a distance of five or six miles over the lines" by two airplanes per army per night. The first such RFC mission occurred on 19 February 1916 when two pilots flying BE2c aircraft from No. 4 Squadron attacked the Cambrai aerodrome. During the mission, one of the British pilots bombed airplane sheds from a height of only 30 feet. Maj Gen Hugh Trenchard, the RFC commander-in-the-field, directed his pilots to gain experience in night flying on the British side of the lines. Quite understandably, these airmen were required to fill out reconnaissance reports.[31]

Inevitably, the disparity between the perceived roles of the RFC emphasizing observation and the RNAS pressing for bombardment led to conflict. Such confrontation later erupted over RNAS land-based strategic bombing. Foreseeing the availability of Sopwith 1½ Strutters, the Admiralty made plans in early 1916 to assault German war industry in Essen, and Dusseldorf. Fearing that proposed flights from Detling, near Maidstone, England might inadvertently violate Dutch neutrality, the Admiralty approached the French with the idea of a joint venture on the continent.

Support of the BEF commander was sought and easily obtained. In fact, General Haig insisted that unless the flights would cross the British lines, he was "not concerned and [saw] no necessity for his concurrence to be obtained." Yet Trenchard and Lt Gen David Henderson, the director of Military Aeronautics, prevailed upon Haig to reverse his stance toward the RNAS wing at Luxeuil, France. The conflict between the RNAS and RFC had only just begun.[32]

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4. Christienne and Lissarague, 83.

5. Alex Imrie, *Pictorial History of the German Army Air Service, 1914–1918* (Chicago: Henry Regnery, 1973), 23–24.

6. Ibid., 24; Ernst W. von Höppner, "Germany's War In the Air: A Retrospective on the Development and the Work of Our Military Aviation Forces in the World War," trans. J. Hawley Larned (Leipzig: Köhler, 1921), bound typewritten translation in the Air University Library (AUL), 40.

7. Christienne and Lissarague, 62–64.

8. Sous-Lieutenant Vincente Almandos Almonacid, "Etudes Relatives a l'Aviation de Bombardement" (Studies Relative to Aviation Bombing) [late-1917?] trans. no. 107, RG 120, National Archives (NA).

9. C. F. Snowden Gamble, *The Air Weapon: Being Some Account of the Growth of British Military Aeronautics from the Beginnings in the Year 1783 until the End of the Year 1929*, vol. 1 (London: Oxford University Press, 1931), 238; Air-Commodore Charles R. Samson, *Fights and Flights* (London: Ernest Benn [1930]), 177–79.

10. Samson, 188; Neumann, 176–77; Wilhelm Siegert, "First German Bomber Squadron Attack on Dunkerque," trans. Ursula E. Wolff, *Cross and Cockade Journal* (US) 13, no. 4 (Winter 1972): 322–24; "The Necessity for a Profound Study of the Bombing Section of Aviation with a View to Determining Rules for Employment," n.d. [19 January 1918 on folder in pencil], World War I Night Aviation Collection, United States Air Force Historical Research Agency (AFHRA). One author found that German air

units did sporadic night bombing as early as December 1914, see Kennett, 52–53. A photograph of an Otto pusher is found in John H. Morrow Jr., *Building German Airpower, 1909–14* (Knoxville, Tenn.: University of Tennessee Press, 1976), 98.

11. C. M. White, *The Gotha Summer: The German Daylight Air Raids on England, May to August 1917* (London: Hale, 1986), 33–34.

12. Christopher Cole and E. F. Cheesman, *The Air Defence of Britain 1914–1918* (London: Putnam, 1984), 28–29.

13. Zeppelin L6 started on the mission but was forced to turn back due to engine problems. Cole and Cheesman, 4–25; Douglas H. Robinson, *The Zeppelin in Combat: A History of the German Naval Airship Division, 1912–1918*, 3d ed. (Seattle: University of Washington Press, 1980), 58–60. Forward bases were soon established at Brussels, Maubeuge, and Controde. See Imrie, 29–30.

14. Höppner, 40.

15. Ernest Dudley, *Monsters of the Purple Twilight: The True Story of the Life and Death of the Zeppelins, First Menace from the Skies* (London: George G. Harrap & Co., 1960), 36–37. A photograph of an observation car is on page 32.

16. Cole and Cheesman, 51–53; Robinson, 74.

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19. Kennett, 45–46; G. W. Haddow and Peter M. Grosz, *The German Giants: The Story of the R-Planes, 1914–19* (London: Putnam, 1963), 1; Bruce, 261–68.

20. White, 34–35; Morrow, 74–75.

21. Kennett, 52.

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24. Capitaine Jean-Baptiste Personne, "Bombardements de nuit," 30 April 1917, World War I Night Aviation Collection, SHAA.

25. Neumann, 49, 180; Robert Casari, "The Development of German Air Aircraft, 1914–18," *Cross and Cockade Journal* (US) 1, no. 3 (Autumn 1960): 7–8; Höppner, 75.

26. Christienne and Lissarague, 89–90.

27. Ibid., 89–90, 100–2; Peter Kilduff, "The History of Groupes de Bombardement 4 and 9," *Cross and Cockade Journal* (US) 15, no. 1 (Spring 1974): 3.

28. Imrie, 31; Morrow, 74–75.

29. Imrie, 40–41; Neumann, 164–65, 179.

30. Wise, 133–34, 139, 143–48.

31. Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 2 (Oxford: Clarendon Press, 1928), 183–84.

32. Policy statement on air bombing issued by GHQ BEF, 3 June 1916, quoted in Neville Jones, *The Origins of Strategic Bombing: A Study of the Development of British Air Strategic Thought and Practice up to 1918* (London: William Kimber, 1973), 79–81, 97–98.

Chapter 3

Tactical Night Bombardment

Tactical bombardment pertains mainly to those objectives located in or near the ground battle zone. In 1917 Col William "Billy" Mitchell defined *tactical bombardment* as bombing occurring within 25,000 yards (15 miles) of the front. Targets typically include enemy airfields, railway lines, supply dumps, munitions depots, troop and convoy movements, cantonments, bivouacs, assembly points, command posts and headquarters of frontline units, and similar objectives which have an immediate bearing upon the ground campaign. Bombardment aviation attacks these targets by day and night.[1]

Tactical aerial bombardments had been carried out from the opening days of the First World War. When it was first organized, the French GB 1 was considered an extension of ground artillery. As such, the bomber crews limited operations to within 30 miles of the front lines. Yet, since the desire to take the war to Germany could not long be contained, strikes were soon carried out against targets at Freiburg, Essen, and Ludwigshafen. Unfortunately, the limited bomb load capacity and inadequate endurance of operational bombers reduced the effectiveness of strategic raids. When increasingly competent German air defenses were factored into the equation, such forays proved too costly to continue. By the second half of 1915, the French were among the first to turn toward routine tactical employment of bombardment aviation.[2]

Several benefits could be gained by using early bombing craft against objectives within the battle zone. Since less fuel was needed, more bombs could be carried. Moreover, it was possible to send the bombers on more than one mission in a single day or night. For example, one RFC pilot made six raids against German billets "immediately behind the line" during one night late in 1917. Briefer penetrations over hostile territory reduced exposure to enemy fighter and AAA defenses, and a switch to night, tactical bombing narrowed the threat even further since fighters rarely flew at night and AAA was

much less accurate. The opening of the 1916 campaign along the Verdun, France, sector demonstrated these advantages.[3]

Formation flying became standard for day bombers as did attempts to provide fighter escorts in the high-threat daytime skies over Verdun. However, flying under the cover of darkness offered the greatest opportunity for successful tactical bombardment.

Germany's Opening Offensive

The Germans carried out numerous night bombardment missions against French railway yards and airfields during the opening stages of their offensive. In one such operation, 18 C-planes dropped approximately 1,500 pounds of explosives in the vicinity of Amiens, France, without losing a single airplane. Yet for all the heroic efforts of German aviation, only 4,500 pounds of bombs were dropped during day and night missions in support of the February ground advance. Such limited tonnage could do little to stem the continuous flow of supplies into the French sector. The task of isolating the French fell to German heavy artillery. The lack of specialized German bombardment aircraft was clearly evident at Verdun—only two early-model G-planes were available during most of the offensive.[4]

As a supplement to the limited-capacity C-planes, the German high command incorporated dirigibles into its air plan for Verdun, designating them for night missions against enemy supply lines. However, as attested by the assault on Nancy, France, during the night of 22 February 1916, the German airships were not up to the task when faced with a combination of heavy French AAA defenses and poor winter weather. Of four airships employed during the operation (SL7, LZ77, LZ88, and LZ95), only one was able to bomb the objective. The other three were either destroyed or forced to turn back. Already overburdened, the kagohls would receive little lighter-than-air bombardment support during the battle.[5]

Slowly the tide turned toward French air superiority in the sector. Germany's effort to deny French use of the airspace over Verdun had required continuous daytime employment of its air assets along the front. Such flying fatigued both men and

materiel. Eventually the French gained superiority in fighter strength and forced German airpower on the defensive. While kagohl strength had increased to four units by April, the squadrons were nevertheless obliged to give up bombardment for defensive support missions. Their main duties now became daylight contact patrol and aerial combat. Even the G-planes, designed specifically for bombardment, flew defensive missions behind the German lines. With the loss of air superiority, the German air service could do little to prevent resupply of the French defenders.[6]

French Night Flights

French bombardment units fared somewhat better than the kagohls during the fighting at Verdun. Though German pursuit aircraft initially inflicted a high loss rate on the outclassed pushers, the French compensated by increasingly flying under cover of darkness. As one example, Escadrille MF 25, the first French bomber unit to arrive in the Verdun sector, became a fully operational night bombardment unit in April 1916. Interestingly GB 3, the first French night bombing group (recognized as such on 11 March 1916), did not participate at Verdun. The group remained at Malzeville until April when it moved to Esquennoy in the Somme sector.[7]

While the French were able to continue bombing the 14 rail lines feeding into the Verdun sector, little lasting success was achieved; "continuous" day and night bombardment was necessary yet impossible with existing capabilities. An experimental British study performed in the last year of the war illustrates the difficulty of putting railroads out of commission through aerial bombardment. The study found that the damage caused by the direct hit of one 112-pound bomb could be repaired in "one to one and a half hours." The track would be out of operation for the added time required to get repair crews to the scene. Night bombings might have increased the time delay further if crews were compelled to wait for daylight before starting their repair work. Given German reliance on its rail net for resupply, it seems likely that sufficient laborers would have been close at hand for repair of important track sections.[8]

Interestingly, the British tests disclosed that only one bomb in four (112 or 230 lb?) dropped from a height of 500 feet hit close enough to destroy a double track railway. Only night fliers could attempt such a low pass, and only along undefended sections of track. French night bombers likely delivered many of their bombs from a higher altitude.

If the bombing accuracy noted in the British tests were an indication of French night bombardment performance at Verdun, then German resupply was little hindered. Only six to 12 French planes (each with a 200-kilo bomb load) could routinely be employed in night bombing raids, weather permitting. As the fighting at Verdun waned by late September, most of the French bomber units had already been transferred to the Somme sector.[9]

The Battle of the Somme

Applying lessons learned at Verdun, the French dispersed their bomber bases more widely over the Somme sector; the planes then flew different routes to their objectives. Thus they achieved a more complete reconnaissance of the region while at the same time complicating the task of the German air defense system. Additionally, the French often sent Voisin or Bréguet-Michelin gunships (equipped with 37-mm guns) ahead of the main night assaults in an effort to neutralize enemy searchlight defenses. Finally, the French air service brought German airfields under systematic night bombardment. Presumably this was to aid the day fliers in gaining and maintaining air superiority. At the same time, French night bombers continued to give attention to German rail targets and troop concentrations.[10]

British bombing efforts on the Somme remained primarily daylight operations. Though both the British (RFC) and the French had been able to keep air superiority over the front for much of 1916, the French increasingly preferred to bomb at night. Here was a fundamental difference in bombing philosophy between the Allies. French authorities supported an expansion of night bombing while the RFC leadership did not.

Fortunately the accomplishments of French night bombardment aviation in the last six months of 1916 were

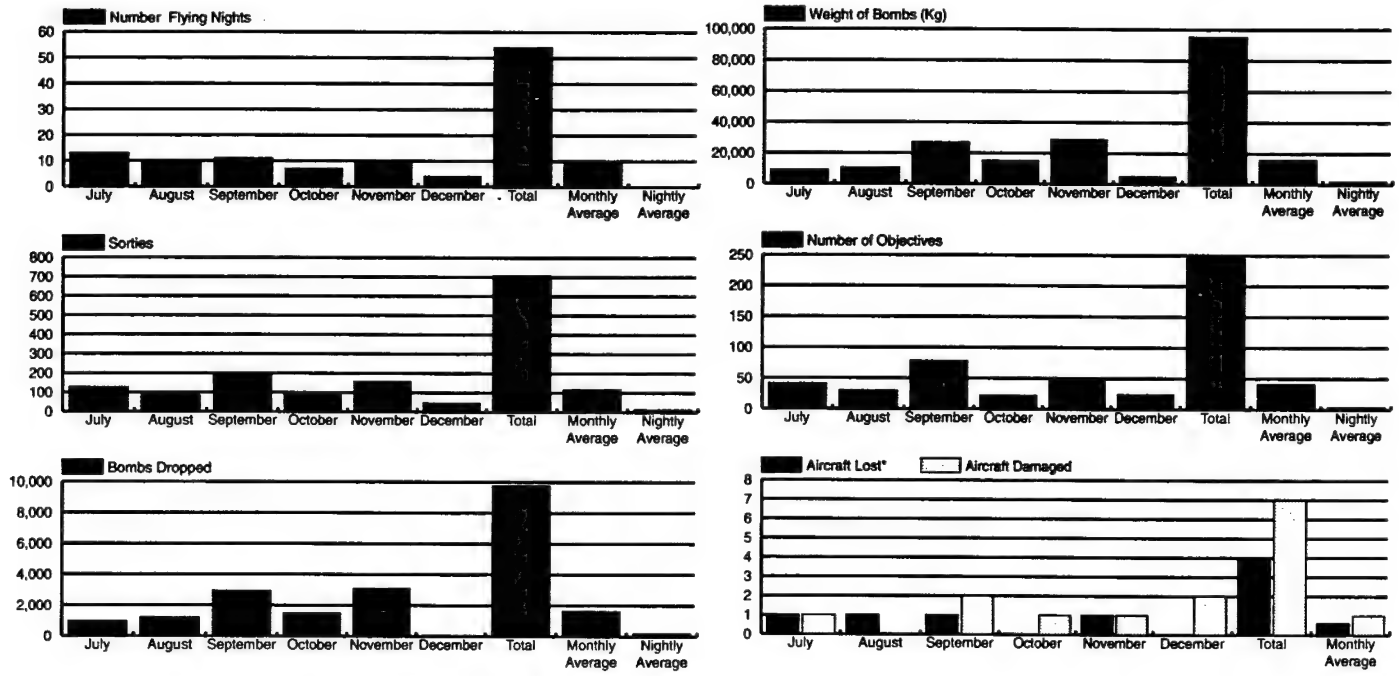
preserved and offer valuable insight. Probably the most striking observation to be gained from figure 2 is the limited capacity of French bombardment. Remember that night bombardment during this period represented nearly the totality of French air service bombing operations. Aerial bombardment was carried out an average of only nine nights per month, with poor winter weather a likely factor in reducing operations to a low of four nights in December.

Additionally, the 13 sortie average per flying night delivered less than 2,000 kilos of bombs against only four targets. Railway objectives were overwhelmingly targeted from late summer to early fall, especially in the opening weeks of the offensive, in an attempt to reduce the flow of supplies to the German battlefront (fig. 3). Enemy troop concentrations and command facilities in towns and cantonments were similarly targeted during the period of fighting.

During October the Germans began to turn the tide in the air battle over the Somme. In response, the French air service commenced systematic night bombing of German airfields. The only previous aviation-related objective was the airfield hangar at Tergnier bombed on the night of 16–17 September. Attacks against German airfields reached their peak in November 1916.

These attacks constituted the first time in the study period that railways were not the most frequently targeted objectives of French night bombardment. As the offensive came to an end and winter weather set in, the French turned their night bombers against more strategic targets. While French bombardment played a minor role in the events of July through December 1916, night flying allowed it to operate with relative ease. The extremely low loss rate exacted during combat missions shows the value of night flying (fig. 2). As a means of comparison, more French bombers were lost during the daylight raid against Oberndorf, Germany on 12 October 1916 (eight, including three gunships) than during six months of night operations. If the figures are accurate, the combination of lost and damaged aircraft amounts to less than 2 percent of the total sorties flown during the period!

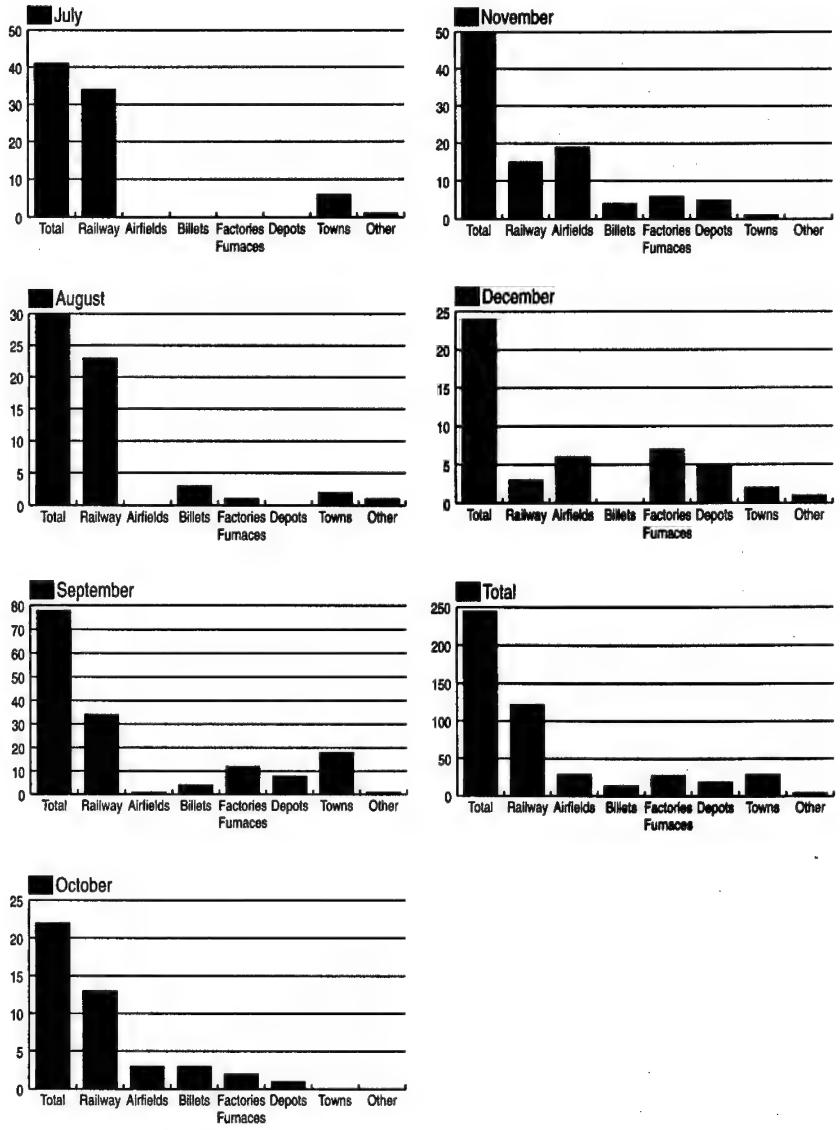
During the battle of the Somme, RFC bombers were mostly used in daytime to support artillery and infantry and to interdict



*Lost means did not return from behind enemy lines for whatever reason; Damaged includes from hostile actions or from hard landings. X = illegible
The Oberndorf raid of 12 October 1916 is not included in calculations, though listed in source material as a night raid. Figures are a best estimate from imprecise source material.

Source: *Operations de Bombardement de Nuit Effectuees par l'Aviation de Bombardement, July–December 1916,* World War I Night Aviation Collection, SHAA.

Figure 2. French Night Bombardment Aviation, July–December 1916



+Railway lines, passenger and freight stations *Billets, bivouacs, cantonments
The Oberndorf raid of 12 October 1916 is not included in calculations, though listed in source as night raid, was in fact a day operation.
Figures are a best estimate from imprecise source material.

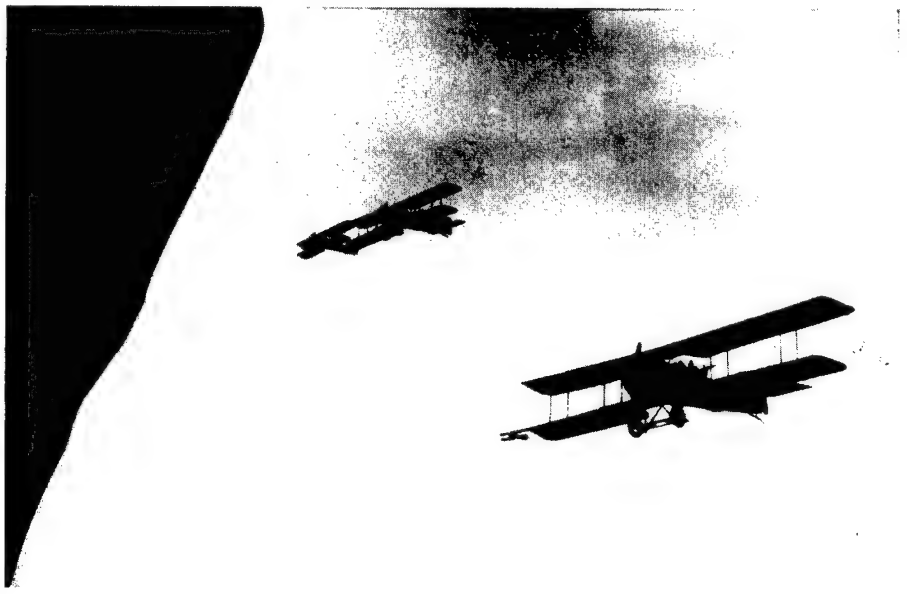
Source: *Operations de Bombardement de Nuit Effectuees par l'Aviation de Bombardement, July–December 1916,* World War I Night Aviation Collection, SHAA.

Figure 3. Types of Objectives for French Night Bombardment Aviation, July–December 1916

tactical targets such as railroads and lines of communication. Many of the tactical bombing missions were nuisances, designed to divert German fighter strength from the front lines. Such action assisted the British in maintaining air superiority and increased the effectiveness of ground artillery.

The introduction of Roland and Halberstadt fighters during the fall of 1916 made RFC daylight bombing increasingly costly. Instead of turning toward the night skies, the British continued day operations with a new emphasis on targeting German airfields. Additionally the RFC secured Sopwith 1½ Strutters, which had been destined for RNAS No. 3 Wing at Luxeuil, to redress the growing imbalance over the front.[11]

Due to improvements in the British fighter arm, German kagohls were again forced into a defensive role during most of the battle of the Somme. Kagohl 1 was present at the start of the offensive in July 1916. Three additional kagohls moved into the sector with the end of active fighting at Verdun. Their most important contribution during the fray was in providing protective escorts for observation planes. As at Verdun, the German air service was unable to provide wide-ranging tactical bombardment in support of the ground war.[12]



Bréuget

Changes in French Aviation

At the beginning of 1917, French bombardment aviation was far from reestablishing extensive daylight capability. The Paul Schmitt bombers which performed day work in four escadrilles (PS 125–128) proved too slow and cumbersome. Equally unsatisfactory for night operations, the Schmitt bombers were a procurement failure and soon removed from service. The French air service had to await the arrival of the Bréguet 14 B 2 late in 1917 before day bombing would gain equal footing with night bombardment. The Voisin Type 8 replaced the less capable Type LA 5 for night use during this time. While the Voisin 8's more powerful Peugeot engine offered greater lifting capacity, it was subject to chronic breakdown causing night aviators to worry about forced landings. The problem with French night bombardment aviation in 1917 was not one of quantity of aircraft but one of quality.[13]

Much tactical night bombing occurred in the Champagne region during the first half of 1917, followed by operations in the Argonne, and Verdun sectors. Aerodrome attack and counterattack between French and German night bombers became almost routine during the latter half of the 1917 campaign, with each side trying to knock out the other's aerial bombardment capabilities. Not surprisingly, the German attacks, with their heavy-bombardment G-planes, produced greater damage. As an example, Sénard, Lemmes, and Osches aerodromes were hit hard by German bombers on the night of 26 September 1917. Twenty-five French aircraft were destroyed with approximately 20 more damaged.[14]

German night attacks forced the French to more widely disperse their Bessoneau shelters on many aerodromes. Some landing fields could no longer support their full complement of aircraft. After housing up to five escadrilles during the August 1917 offensive, Lemmes could now only handle one or two flights, and Osches was now suitable for two escadrilles—half its previous complement. Many airfields either had to be enlarged or abandoned. Often both French and German planes retired before nightfall to airfields distant from the front, returning to their home base early in the morning. This way men and machines did not fall victim to the enemy's

night attacks—at a cost of increased fatigue and decreased operational efficiency (see table 4).[15]

The increasing amount of airfield bombardment led to the establishment of false aerodromes. These false fields gave the appearance of active aerodromes by day and night in the hope that enemy bombers would be fooled into releasing their bomb loads a mile or two from the real airfields. At night, active fields remained concealed in darkness until an airplane was properly identified through flare signals. Often the aircraft also signaled a unique Morse identifier from a light on the plane. Once ground personnel were satisfied with the identity of the airplane, they illuminated the landing grounds. The

Table 4

Distribution of French Bombardment, September 1917

Group	Location	Escadrilles	
		Day	Night
GB 1	Sénard	Sop 66	VB 110 VB 114
GB 2	Malzeville	Sop 11	VB 101 CEP 115 MF 130
GB 3	Champion	Sop 128	Sop 107 VB 113? VB 125 PS 126 PS 127
GB 4	Luxeuil	Sop 29 Sop 123 Sop 129 Sop 131	
GB 5	Ochey		BR 117 BR 119 BR 120
Independent Units			
Vadelaincourt			MF 25
Dunkirk			V 116

GB 5 increasingly was used for day operations as the transition to the Bréguet 14 B 2 neared completion. Capitiane Bouchet commanded GB 1 in 1917.

Source: Adapted from a transation of Capitiane Bouchet, "Chaalis's Classes For Advanced Students," n.d. [but pre-1 October 1917], 25–26, RG 120, NA.

lights were extinguished as soon as the airplane had landed. False aerodromes were likely most effective during periods of poor visibility when ground details were indistinct.[16]

Britain's No. 100 Squadron

British night bombardment advanced in February 1917 with the formation of No. 100 Squadron. As the first RFC squadron dedicated strictly to night bombardment, the unit learned its vocation through practical experience—flying night missions behind the lines. In using obsolete FE2b and BE2e aircraft, the squadron paralleled French night bombardment escadrilles which also flew aircraft with limited capacity for destruction. For much of the war, Allied night bombardment was the "poor relation," receiving hand-me-down aircraft no longer fit for day use.

The FE2b had first flown in 1915 and had a maximum ceiling of 9,000 feet, a lifting capacity of three 112-pound bombs, and no more than three hours endurance under its maximum load. Nevertheless, British aviators carried out many audacious night attacks with their FEs.[17]

No. 100 Squadron's first wartime mission was an attack against Douai aerodrome on the night of 5 April 1917. Manfred van Richthofen, assigned to the field at the time, noted that the planes came in as low as 150 feet to drop their bombs. He also found that the attack was something to be enjoyed, declaring that many pilots, himself included, manned machine-gun posts as if at a turkey shoot. The FEs and their paltry payloads caused some physical damage to the airfield but failed to reduce German morale. If one is to believe Richthofen's story, the attack enhanced the "Red Baron's" spirits.[18]

The squadron flew nine missions during the month of April 1917, attacking airfields, railway stations, trains, and cantonments. Night operations continued at the greatest possible pace throughout the summer and fall in support of the Battles of Arras, Messines, and Third Ypres. On the night of 3–4 July 1917, No. 100 Squadron struck Ramilies Chin and Chateau du Sart aerodromes. Thirty German aircraft were destroyed on the ground. With the termination of the Third Battle of Ypres in October, No. 100 Squadron moved from

Trezennes aerodrome, near Aire, to Ochey. By that time Nos. 101 and 102 Squadrons had already been performing night bombardment duties with the FE2b. Organized British night bombardment, nonexistent for the first two- and one-half years of the Great War, would constitute nearly half of British bombardment aviation by war's end.[19]

Amerikaprogramm

German military aviation was profoundly influenced by the United States's declaration of war in April 1917. While German authorities fully appreciated the limited capacity for American aircraft production in 1917, they were nevertheless concerned. Skilled American technicians and business leaders sent overseas might be able to immediately increase the output of existing British and French aero industry. To counter this possibility, the Germans began a rapid buildup of air assets under the Amerikaprogramm. The plan was simple: use all available resources to force a decision on the Western Front before American industry was fully geared to war production. It was Germany's only chance.[20]

The kagohls had increasingly become night bombers as the transition to G-planes neared completion. Aerodromes and troop concentrations remained important targets throughout 1917. With the buildup resulting from the Amerikaprogramm, the kagohls took a new designation in late 1917 as part of an overall redesignation of German aviation: Bombengeschwader der Obersten Heeresleitung (Bogohl). Seven Bogohls were in existence by the end of the year, each containing three Bombenstaffeln with an individual strength of six G-planes. The only exception was Bogohl 3, the Englandgeschwader, which contained six staffeln. For the first time in the war, Germany had air units employed strictly for bombardment.[21]

French Bombardment Aviation Reorganization

The Bréguet 14 B 2 was the long-awaited French daylight bomber. The plane began to enter the French air inventory in quantity by the end of 1917. While the Bréguet transformed many existing escadrilles into daylight units, other escadrilles

within the same group remained dedicated to night bombing. These GBs were known as mixed groups. Since problems resulted in the mixed units from trying to combine two distinct functions within one organization, French bombardment aviation was reorganized in January 1918. The mixed GBs were separated into unique day-flying and night-operating units. Each GB contained three escadrilles as follows:

GB 1 became GB 1 (night) and GB 6 (day),
GB 3 became GB 8 (night) and GB 3 (day), and
GB 7 became GB 7 (night) and GB 5 (day).

Additionally, GB 4's five Sopwith-equipped escadrilles began converting to the Bréguet the same month. As the aircraft changeover neared completion, three escadrilles were taken from the group to form GB 9.[22]

Further refinement came with the instruction of 11 February 1918 when most of the French GBs became components of a larger organization, the escadre. The escadres were formed by order of Général Pétain to make mass employment of day or night bombardment easier to coordinate and carry out. Escadre 11, containing the French night GBs, was assigned to the strategic blockade of the Briey Basin. GB 8 remained independent to provide tactical night bombardment against targets during the upcoming German spring offensive. In April 1918 the second night bombardment escadre (no. 14) was formed by grouping together GBs 2 and 8.[23]

Spring Offensives

Tactical bombardment intensified on both sides of the front as the 1918 spring offensives approached. Supply depots, railroads, lines of communication, and choke points (such as bridges) close to the front became critically targeted objectives as Allied and German bombardment aviation sought to gain the advantage for their comrades on the ground. The British were forced to abandon nearly two dozen airfields between 21–25 March 1918 as the Germans rapidly advanced westward. However most were damaged and not immediately available for forward staging of German aviation. Once repaired, some of these airdromes became bases for German bombardment

aviation. For example, Bogohl 6 took up residence at Matigny aerodrome in April. Many Allied positions previously safe against German air attack were now subject to bombardment.[24]

Indeed, the number of targets exceeded the capacity of the 72 German bombers committed to the offensives. The lack of an effective day bombing capability was clearly felt. Due to the scarcity of raw materials, German aviation production under the Amerikaprogramm had been limited to existing aircraft types. Resources could not be spared to develop a day bomber. The official British historian conceded the gravity of the situation, declaring that with more aircraft the bogohls might possibly have changed the outcome of the war. While inflicting serious damage, notably the destruction of two British ordnance depots in May, German bombardment aviation nevertheless failed to turn the tide.[25]

To cope with the German offensives, the British reorganized their tactical bomber units in March 1918. Day and night wings were organized with 54th (Night) Wing containing Nos. 58, 83, 101, 102 Squadrons, all flying the FE2b. The overriding objective of British tactical night bombing missions was to hamper German resupply. However the light bombardment aircraft of the 54th Wing were unable to frustrate enemy activity of such enormous scale. Even had the weather cooperated and allowed British bombing every night, the damage inflicted would likely have little changed the final outcome—a massive German push into Allied territory. The FEs, with their small payload, proved to be little more than a nuisance.[26]

On the ground, Allied forces prevailed and began counter-attacking in July 1918. By then an American army was on the front. British and French day and night tactical bombardment aircraft flew in support of the United States Army during its ground offensives, especially against the Saint Mihiel salient. To be expected, numerous railway and airfield objectives were targeted to reduce the German ability to respond to the American assault.[27]

As the offensive kickoff time neared, Allied aerial bombardment progressed from outlying objectives to those closer to the battle zone. However for purposes of deception the tempo of bombing remained constant prior to the start of the campaign. During the day of attack, enemy troop concentrations and

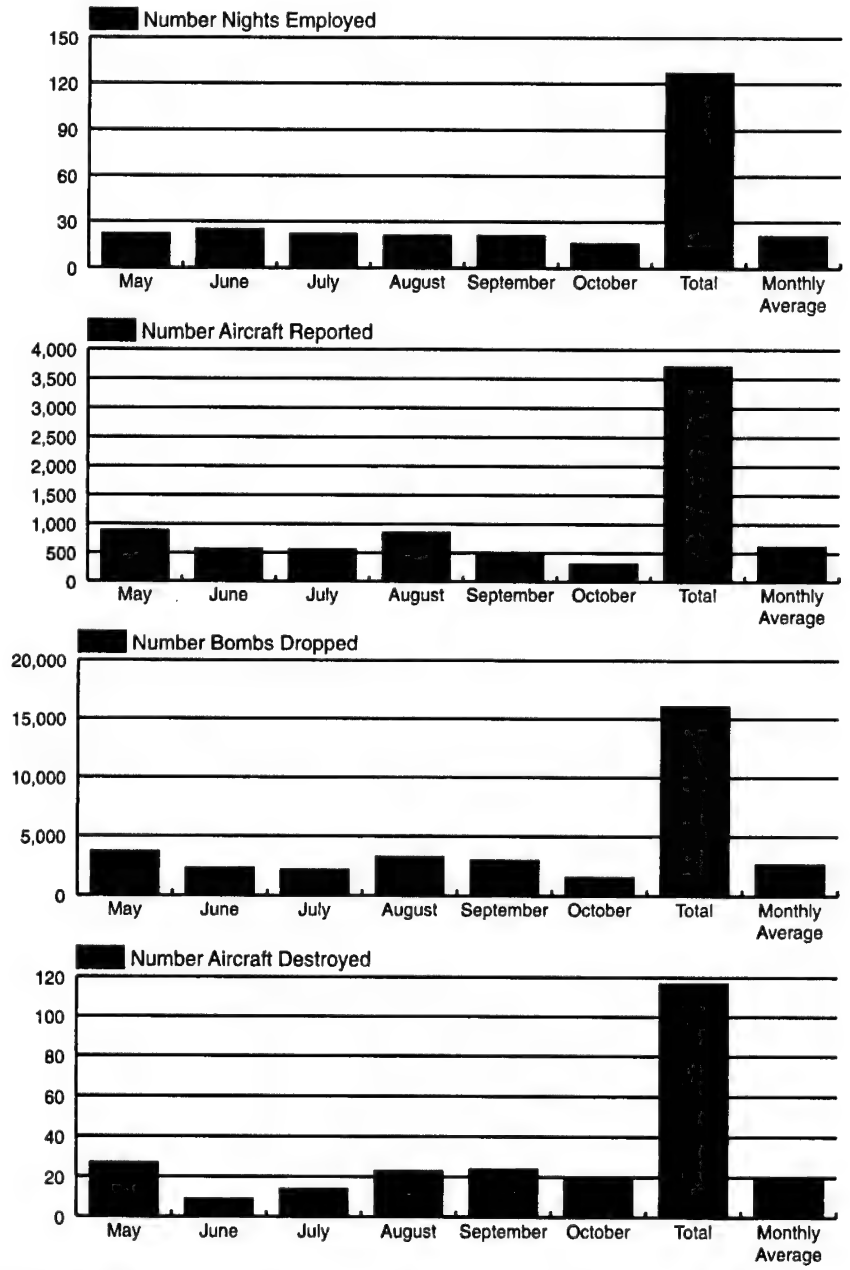
command posts in support of the ground forces were priority targets. Interestingly, the Metz-Sablon railway was targeted through all stages of the offensive.

An important addition to bombardment aviation occurred during the war of movement in 1918. Belligerents mounted bomb racks on observation and pursuit aircraft for attacks against personnel. Rather astonishingly, 67 percent (900 long tons) of bombs dropped by the British between 1 January and 15 May 1918 were Cooper 25-pound antipersonnel fragmentation bombs. In fact, fighter and reconnaissance squadrons accounted for 46 percent of all British bombardment during the period. While few enemy casualties resulted from antipersonnel bombings, these bombings were important for impeding movement and creating disorganization.[28]

Though aerial opposition remained intense, the Allied air services' ability to mount both day and night bombardment helped keep the German ground forces on the defensive until the armistice of 11 November 1918. The German night bombers continued tactical operations at a feverish pace (fig. 4) Rarely did a night go by without bombardment missions. Many G-plane crews carried out more than one sortie per night. Again, most striking is the low loss rate. Even if the total number of German bombers reported during the period is in error by 50 percent (1857 instead of 3714), the overall loss rate to British defenses amounts to little more than 5 percent of all German bombing sorties. Such results (in the face of stiff defenses) reveal the security of flying at night (see tables 5–10).

The Minor Role of Tactical Night Bombardment

Tactical night bombardment clearly played a minor role during the First World War. Limited aircraft capabilities reduced the effectiveness of the bombardments, while poor weather conditions often prevented follow-up raids. Therefore, only short-term isolated gains seemed possible. Yet tactical aerial bombardments supported the ground forces by striking targets that could not be effectively targeted by artillery. Bombardment aircraft were first of all more mobile than



Source: Adapted from H. A. Jones, *The War in the Air* (Oxford: Clarendon Press, 1928), appendix 43.

Figure 4. German Bombardment on the British Front, May–October 1918

Table 5

Order of Arrival for British Night Bombardment Squadrons in France

Date	Squadron	Aircraft
1916		
? (night bomb by 10 Nov 1916)	5 (Naval)	Sop 1½
?	3 (N) Wing	Sop 1½
1917		
28 March	100	FE2b, BE 2e, HP
25 July	101	FE2b, BE12
24 September	102	FE2b
17 October	A' (Naval) later 216	HP
1918		
10 January	58	FE2b, HP
3 March	207	HP
4 March	83	FE2b
1 April	214	HP
26 April	148	FE2b
2 June	149	FE2b
4 August	297	HP
31 August	115	HP

Source: Adapted from Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force* (Oxford: Clarendon Press, 1928), appendix XXIX; C. P. O. Bartlett, *Bomber Pilot, 1916–1918* (London: Ian Allan, 1974), 29, 53; Gordon Burge, *The Annals of 100 Squadron: Being a Record of the War Activities of the Pioneer Night Bombing Squadron in France during the period March 1917 to November 1918, including its Operations against German Towns, whilst serving in the Independent Force of the R.A.F.* ([1919]; reprint, London: Bivouac Books [1975]), 3.

ground batteries. They could provide covering fire while artillery units moved into new positions. Additionally bomber planes could strike troop concentrations protected from artillery behind hills or in ravines. Finally tactical bombardment could strike such fleeting targets of opportunity as trains or motor convoys out of sight of artillery spotters.

Though the results of tactical bombardment aviation were small, the capability to perform such missions was nonetheless important, since bombers increased the options available to ground commanders. Flying under cover of darkness increased the flexibility of air operations and kept bomber losses at an acceptable rate. Yet the impact of tactical bombardment was hampered without daylight bombing capacity. Gains made during the night were often lost without rapid follow-up.

Table 6

Royal Air Force Night Bombardment on the Western Front, 11 November 1918

Brigade	Wing	Squadron	Location	Aircraft Type
IX (HQ)	54th	83	Estree-en-Chaussee	FE2b
		207		HP
	82d	58	Provin	HP
		214	Chemy	HP
I	10th (Army)	148	Erre	FE2b
II	11th (Army)	149	St. Marguerite	FE2b
	65th	38	Harlebeke	FE2b
III	90th	102	Bevillers	FE2b
V	22d (Army)	101	Hancourt	FE2b
VIII	83d	97	Xaffrevillers	HP
(Independent Force RAF)				
		100	Xaffrevillers	HP
		115	Roville	HP
		215	Xaffrevillers	HP
		216	Autreville	HP

The FE/2b was used for short-range night bombing. Each squadron had an average of 18.5 aircraft assigned. Handley Page (HP) 0/100 or 0/400 were used for long-range night bombing. Each squadron had 10 aircraft assigned.

Source: Adapted from Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force* (Oxford: Clarendon Press, 1928), appendices XXVI, 125–129.

Table 7

Distribution of German Bombardment Aviation, 28 July 1918

Bogohl	Staffeln	Region	Airfields
1	1–3	Sedan	Malmy
2	10–12	Laon	Clermont-les-Fermes, Boncourt
3	13–18	Ghent	Gontrode, Mariakerke, Oostacker
4	19–21	Somme	Giizancourt
5	4–6	Rethel	Seraincourt
6	7–9	Topurnai	Froidmont, Marquain, Templeuve
7	22–24	Somme	Estrees-en-Chaussee
8	25–27	Lorraine	Boulay (Bavarian unit)
Rfa			
500	–	Ghent	Scheldewindeke
501	–	Dinant	Morville

Source: "Summary of Air Information," no. 37, 2dS GS, 4 August 1918, AUL; "Vizefeldwebel Kurt Weil," *Cross and Cockade Journal* (US) 3, no. 4 (Winter 1962): 327.

Table 8

US Air Service Night Bombardment Squadrons, 1918

Squadron	Organized	Training Location	Arrived Front
92	1 Sep 1917	Ford Junction, England	–
140	1 Nov 1917	Ford Junction, England	–
155	1 Dec 1917	RAF Lake Down, England	9 Nov 1918
326	7 Jul 1918	Ford Junction, England	–

The 92d and 140th Aero Squadrons did not begin training for night bombardment until mid-August 1918. The 155th Aero Squadron originally trained as a day bombardment squadron and was ordered to report to Colombey-les-Belles on 11 November 1918 to serach for missing planes.

Source: Lucien H. Thayer, *America's First Eagles: The Official History of the U.S. Air Service, A.E.F. (1917–1918),* Donald G. McGee and R. James Bender, eds. (San Jose, Calif.: R. James Bender, 1983), 243; AEF Progress Report, 9 April 1919; Capt J. Stuart to Col A. Monell, memorandum, 20 November 1918, in Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919,* National Archives Microfilm Publications, no. 990, vol. B-9 (Washington, D.C.: National Archives and Records Administration, 1974), 97–101; "American Air Service in Training With R.A.F., British Isles," Gorrell, vol. B-5, 45–46, 60.

Table 9

United States Naval Aviation Forces in Europe, Northern Bombing Group, Night Wing

Squadron	Estimated Date of Operation	Proposed Location
1	15 Jul 1918	Saint Ingelverts
2	1 Aug 1918	Saint Ingelverts
3	15 Aug 1918	Champagne
4	1 Sep 1918	Champagne
5	1 Sep 1918	
6	15 Sep 1918	

Squadrons 3 and 4 were not organized before the armistice. Squadrons 5 and 6 were elminated by the Department of the Navy after the original projections.

Source: Adapted from a memorandum to Captain Hutch Cone, 21 May 1918, quoted in a report by Lt Col Arthur Christie (for Joint Army and Navy Board on Aeronautic Cognizance?), 17 August 1919, 8, RG 18, NA; Roger M. Emmons, "The First Marine Aviation Force, Part Two," *Cross and Cockade Journal* (US) 6, no. 3, 272.

Table 10

Comparison of Allied and Enemy Night Bombardment Aviation Aircraft Strengths

30 July 1918							
American	**Belgian**	**British**	**French**	**Italian**		**German**	**Austrian**
0	10	169	210	47		222	67
Total		**436**					**289**
11 November 1918							
American	**Belgian**	**British**	**French**	**Italian**		**German**	**Austrian**
0	8	190	247	80		268	11
Total		**525**					**279**

Source: AEF Progress Report, 7 May 1919, RG 18, NA.

Notes

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2. Lee Kennett, *A History of Strategic Bombing* (New York: Schribner, 1982), 27–28; Charles Christienne and Pierre Lissarague, *A History of French Military Aviation*, trans. Francis Kianka (Washington, D.C.: Smithsonian Institution Press, 1986), 89–90.

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5. Imrie, 37.

6. Christienne and Lissarague, 95–96, Imrie, 32–33.

7. Christienne and Lissarague, 100–102.

8. Statistics Branch, General Staff, War Department, "Statistical Analysis of Aerial Bombardment," report no. 110, 7 November 1918, in Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919*, National Archives Microfilm Publications, no. 990, vol. B–7 (Washington, D.C.: National Archives and Records Administration, 1974), 99.

9. Christienne and Lissarague, 102.

10. Ibid.

11. S. F. Wise, *Canadian Airmen and the First World War: The Official History of the Royal Canadian Air Force*, vol. 1 (Toronto: University of Toronto Press, 1981), 363, 368, 376–81.

12. Imrie, 34–35.

13. Christienne and Lissarague, 114–15; Commandant Orthlieb, *Laèronautique Hier-Demain* (Paris: n.p., 1920), 58–59; Simone Pesquiès-Courbier, "Le Groupe de Bombardement 1 Durant la Guerre de 1914–1918: Analyse du Journal de Marche," *Revue Historique des Armées* 152, no. 3 (1983): 97.

14. Christienne and Lissarague, 116–18; Orthlieb, 56–57; Commandant André Voisin, "Report on the Bombardment of the Aviation Fields in the Second Army Zone on the Nights of September 26/27, 1917," stencil no. 718, Information Section, Air Division, Office of the Chief Signal Officer, NA.

15. Orthlieb, 57; Voisin, 1.

16. United States, Army, American Expeditionary Forces (AEF), General Staff, "Summary of Air Information. Second Section, General Staff, [General Headquarters, AEF] G.H.Q.A.E.F. (2dS GS)," 8 April 1918; Montgomery, 20–21.

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18. Burge, 51–54.

19. Ibid., 55–56, 67–70; Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 2 (Oxford: Clarendon Press, 1928), appendix XXIX.

20. Morrow, 95–96.

21. Imrie, 46–49.

22. Christienne and Lissarague, 123; Orthlieb, 60; Peter Kilduff, "The History of Groupes de Bombardement 4 and 9," *Cross and Cockade Journal* (US) 15, no. 1 (Spring 1974): 17.

23. Gen André Voisin, *La Doctrine de l'Aviation Française de Combat Au Cours de la Guerre (1915–1918)* (Paris: Ed. Berger-Leurault, 1932), 66–67; Commandant Henri Langevin, " 'Action de masse' aérienne dans une bataille défensive," *Revue des Forces Aériennes*, January 1930, 30; Commandant Jean Brumelot, "Le 11^{e} Régiment d 'Aviation de Bombardement," *Revue des Forces Aériennes*, January 1930, 132–33.

24. Wise, 483, 494; United States, Army, AEF, General Staff, "Summary of Air Information, no. 13, 2dS GS," 15 May 1918.

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26. Wise, 483.

27. Col Edgar S. Gorrell, *The Measure of America's World War Aeronautical Effort* (Northfield: Norwich University, 1940), 42; "The Plan of Bombardment Aviation," appendix no. 2 to annex no. 3 (Field Orders No. 9) *Plan of Employment of Air Service Units*, 1st American Army, HQ First Army, AEF, 7 September 1918, RG 120, NA.

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Chapter 4

Strategic Night Bombardment

Strategic bombardment deals with the destruction of targets which are not supporting the immediate ground battle. These targets are often located at a distance from the front. During the First World War, the industry and civilian population of enemy cities were important strategic targets. Other areas of strategic value included marshalling areas and arteries for moving manpower and materiel to the front, supply and ordnance depots, arsenals, interior airfields, military and naval bases, mobilization centers, and similar objectives.[1]

Destruction of industry would result in long-term reduction of war reserves; destruction of stockpiled reserves would have a near-term impact on the front when resupply could not keep pace with battlefield attrition. Both types of destruction limited the ability of a nation's armed forces to wage war. However strategic bombardment had another important purpose; it brought the war to the home front. Such bombing was believed to have an important psychological effect on the civilian population. Hence the overarching purpose of strategic bombardment during the First World War was to damage a belligerent's capacity and willingness to wage war by targeting the military, economic, and civilian segments of society.

The idea of strategic aerial bombardment predates 1914. Though dirigibles appeared the only viable facilitators of such bombardment as the war neared, that great prophet of airpower, Clément Ader, had foreseen the day of the great bombing planes. Ader, writing in the 1890s, noted their use against tactical military targets. Yet he proclaimed an important strategic role for bomber aircraft:

> Unfortunately their work will also require them to bomb enemy cities. And how can we expect to avoid such catastrophes? Don't battleships bombard port cities? Since airplanes will drive away or destroy these naval monsters, they may be excused for a few misdeeds of their own!

> The great bombing planes will become veritable terrors! I am convinced that their awesome power and fear of seeing them appear will provoke salutary reflections among the statesmen and diplomats who are the real dispensers of peace and war, and that in the final analysis these planes will serve the cause of humanity.[2]

Although Ader's hope for a peaceful outcome of bomber development failed, his vision of strategic terrorizing did become reality—but not until an airplane with great lifting capacity, extended endurance, and the ability to drop bombs with precision came into existence.

For want of such a plane, the first air strikes at strategic targets were missions made by daring individuals who were willing to take risks to achieve small gains. One example was the attack by Escadrille MF 29, flying the Maurice Farman 7 Longhorn, against the poison gas facilities at Rössler, Germany on the night of 29 July 1915. The MF 7 could lift only about 300 pounds of bombs, and less on long-distance flights. Widespread destruction was beyond the capabilities of such an aircraft. The Farmans inflicted only minimal damage to the Rössler installation.[3]

Bombardment by Airship

The airship appeared as the ideal strategic bombardment platform when war first erupted. On the night of 19–20 January 1915, German dirigibles began a strategic bombing campaign against Great Britain. But British defenses forced the airships to ever-increasing altitudes, making accuracy against military targets impossible; therefore civilian casualties continued to mount with each raid. The night-flying Zeppelins visited England 20 times during 1915. The following year saw a slight increase in the number of successful airship bombing operations flown over the island. Airship losses mounted during the period due to improved British defenses and the hazards of flying into unforeseen bad weather.[4]

Weather forecasting proved difficult for the Germans since most weather patterns move from west to east across Europe. Analysis of pressure changes, wind direction, and cloud patterns over occupied Belgium offered the best

means available to forecast future weather conditions over the British Isles. But these forecasts proved to be inaccurate at times and were often ignored, sometimes with disastrous consequences.[5]

Douglas H. Robinson contends that the raid over England on the night of 23 September 1916 was "for the German Naval Airship Division . . . a turning point in the war." Two of their newest Zeppelins were destroyed during the operation. Several other airship crews watched one of the craft burn. In the clear night sky, the fire could be seen as far as 125 miles away. Pessimism pervaded the division as many flying personnel began to discuss "not their chances of survival, but what they could do when the inevitable catastrophe should overtake them." By the time strategic operations against England were put on hold at the end of November 1916, nine dirigibles had been lost in 43 night raids over the island. Eight were lost in the last seven months alone.[6]

For the German army, 1916 had demonstrated the costliness of airship raids. In June 1917 after airship no. LZ107 raided England, the army suspended all dirigible operations. German army airships had performed 232 strategic and tactical bombing sorties during almost three years of warfare. Twenty-six army airships were destroyed. Refusing to admit defeat, the German Naval Airship Division continued to mount occasional raids over the British Isles until the night of 5–6 August 1918. On that night, Fregattenkapitan Peter Strasser, chief of the Naval Airship Division, and the crew of Zeppelin L70 were lost when the airship went down in flames off the coast of England (table 11). Soon after the division became ineffective even for reconnaissance work.[7]

Germany would no longer depend upon its airships for strategic operations against Great Britain once the G-plane became fully operational. By flying tactical missions, the G-plane crews gained valuable night experience which would later be needed for strategic operations against England. The G-plane proved to be a useful bomber for the duration of the war.[8]

Table 11

German Strategic Raids Against Great Britain

Year	Number Raids	Number Dispatched/ Number Attacked	Destroyed
Airships			
1915	20	49/39	1 bombed by plane
1916	23	164/123	5 by British fighters 2 by British AAA 1 by weather
1917	7	46/29	1 by British fighter 2 by French AAA 4 by weather
1918	4	18/11	1 by British fighter
Total	54	277/202	17
Airplanes **Daylight Phase May–August 1917**			
	8	193/143	6 British fighters 2 British AAA 4 weather
Night Phase September 1917–May 1918			
	19	253/187	7 British fighters 7 British AAA 2 Forced landed in UK
Total	27	446/330	28

Source: Adapted from Cole and Cheesman, *The Air Defence of Britain, 1914–1918* (London: Putnam, 1984), 448.

R-Planes

On the Eastern Front, German strategic air operations were carried out by a unique aircraft type—the Riesenflugzeug (R-plane), an aircraft with a wingspan of more than 138 feet. Later fully functional in the West, R-plane prototypes were flying in the East as early as April 1915. Interestingly, the only specification that put the R-plane in a class by itself was the requirement that the engines had to be "fully accessible, serviceable and capable of being repaired *in flight*" [authors' emphasis]. As engine breakdowns were frequent, such

capability was critical for successful long-range operations. Through the various stages of R-plane evolution, the number of motors per plane varied up to a maximum of six.[9]

Early R-plane experimentation by the firms of Zeppelin-Werke Staaken and Siemens-Schuckert Werke (SSW) was viewed with much skepticism by German military authorities. However by mid-1916, the realization of airship limitations under combat conditions led these same officials to support an expansion of R-plane production. Nevertheless, only 55 to 65 such aircraft would be manufactured before the end of the war, with roughly 30 performing combat operations. Clearly the R-planes were amazing technological achievements. Two British authors contended that they "would have earned lavish praise had they been British products."[10]

Even on the less hostile (for aircraft) Eastern Front, R-planes were soon forced to fly under cover of darkness. During these missions, the aircraft flew at an altitude of between 6,500 and 7,800 feet, and carried up to a 1,700-pound bomb load. Missions routinely lasted from three to five hours. As the number of available aircraft increased during 1915, they were formed into two independent flights. Riesenflugzeugabteilung (RfA) 500 was assigned to Alt-Auz, while RfA 501 was stationed at Vilua. Later the R-planes would commence operations along the Western Front.[11]

Strategic airplane operations against London began with an incredibly audacious solo attack by the crew of a German Albatros C VII aircraft on 5 April 1917. Aided by favorable winds and a full moon, the aircraft reached the capital and dropped five 22-pound bombs. While the British official historian argues that the event was "without particular significance," the mission must have made British home defense personnel take notice that a new threat might not be far over the horizon.[12]

Turk's Cross

In an effort to divide the French and British alliance after the bloodletting of 1916, German authorities began serious consideration of bombarding London by airplane. The plan

came under the code name Turkencrenz (Turk's Cross). The central London business and government district was to be the principle target area for the daylight bombing campaign envisioned in Turkencrenz. Notably included were the newspaper offices on Fletcher Street. As the primary objective of the offensive was to bring about a separate peace with Great Britain, what better way to spread the panic than to bring the bombing home to the press?[13]

Halbgeschwader 1, made up of Staffeln 1, 4, and 6 of Kagohl 1, was the unit selected to carry out this elite operation. The army pilots trained at Heligoland and on the Isle of Sylt, where they learned how to navigate over the North Sea. Surprisingly, German naval pilots who were accustomed to such flying were never incorporated into the army scheme. Interservice rivalry had struck again. On closer observation, this situation appears as a complete reversal of the British RFC-RNAS squabbling over strategic bombardment from Luxeuil. There naval pilots were making long flights over land, while operation Turkenkrenz had military pilots flying across water.[14]

Kagohl 1 was redesignated Kagohl 3 after being reequipped with the improved G.IV-type aircraft. The squadron was informally referred to as the Englandgeschwader because of its strategic mission. Subordinate Staffeln (13–18) were authorized six G.IVs each, although the full complement of 36 aircraft was slow to materialize. In April 1917 the unit moved to new aerodromes at Melle-Gontrode and Saint Denis-Westrem in preparation for the offensive. Engine problems delayed operations against England until 25 May, the date of the first mass daylight airplane raid. The daylight campaign lasted for approximately three months, causing considerable damage to structures in isolated areas. The cost in German aircraft was high, though due mainly to poor weather and not British defenses. Clearly the campaign could not continue indefinitely at a loss rate of roughly 20 percent.[15]

The Gotha night bombing of England began in earnest on the eve of 4 September 1917. Four Englandgeschwader aircraft hit Chatham, England, killing and wounding over 200 naval recruits. Before the month was out, the Germans launched a combined operation utilizing G- and R-planes

against the British Isles. An Allied reconnaissance plane had photographed a R-plane at St. Denis-Westrem three days before the raid, however both RNAS and RFC bombings failed to neutralize this new threat.[16]

Bad weather prevented systematic strategic raids against England during the last quarter of 1917. Though Germany had begun to concentrate all of its available air assets on the Western Front in late 1917/early 1918 in preparation for the spring offensives, raids across the channel continued into the spring. Somewhat surprisingly, only 19 night raids could be mounted by the Englandgeschwader during the eight-month campaign which came to an end in mid-May 1918 (table 11).[17]

German air service night bombers also struck many strategic targets in France during 1917. Bogohl 2 bombed war industry in the vicinity of Nancy. The unit attacked factories at Neuve Maison during four night raids. Dunkirk was a favored German target, with sporadic bombings lasting for upwards of six hours per night. During one such bombing of Petite Synthe aerodrome (near Dunkirk), a RNAS night bomber pilot refused to get out of bed to take cover. He had a mission in two hours (using a Sopwith 1½ Strutter) and was going to get all the rest he could.[18]

British and French Joint Offensives

The British RNAS had flown strategic bombing missions from Dunkirk against the German naval bases and Zeppelin sheds in Belgium from the early weeks of the war. Yet the limited ability airplanes achieved only minor successes. It was not surprising that strategic bombing operations were suspended in June 1916. The campaign resumed later in the year when improved equipment became available. By then, the strength of German air defenses forced the RNAS bombers to fly under cover of darkness.[19]

The RNAS and the French air service planned a joint bombing offensive designed to destroy steel manufacturing in the Saar-Lorraine-Luxembourg region. Decreasing the U-boat threat at its source was the primary reason for RNAS interest. To begin the offensive, the RNAS argued that it needed 50 heavy bombers, 80 light bombers, and 50 long-range fighter

escorts. The RFC took issue with the estimate, and ultimately diverted at least 60 Sopwith 1½ Strutters previously destined to the RNAS when fighting intensified on the Somme in mid to late 1916. Additionally, the French units involved in the strategic offensive sought the use of 1½ Strutters, further limiting the RNAS buildup. Throughout the spring and summer, GB 4 and RNAS No. 3 (N) Wing, stationed at Luxeuil, carried out sporadic joint and individual missions, by day and night, while waiting for enough aircraft to begin a general offensive.[20]

Surprisingly, a long-distance daylight raid against the Mauser arms factory at Oberndorf, Germany, was selected as the first large-scale joint mission of the untested (in combined operations) Allied units. After suffering heavy losses during the 12 October 1916 raid, GB 4 restricted the operation of its obsolete Farman and Bréguet aircraft to darkness. Both units then moved to Ochey airfield to concentrate on the German steel industry of the Saarland, Germany. The French unit conducted several night missions during November and December 1916 against these targets (table 12).[21]

No. 3 (N) Wing continued to perform mainly daylight missions, and received its first Handley Page 0/100 during this time. The aircraft had a cruising speed of 60 to 75 miles per hour, an endurance of 9½ hours with a load capability of ten 112-pound bombs, and a bombing altitude of 6,000 feet. Up to sixteen 112-pound bombs could be carried internally for shorter-distance missions. The aircraft's slow speed and lack of maneuverability necessitated duty as a night bomber.[22] RNAS plans called for the development of a squadron of Handley Page bombers within No. 3 (N) Wing.

Since factories were not producing the planes in any quantity during the winter of 1916–17, the unit had only two by March 1917. The first night mission with one of these aircraft occurred on 16–17 March, against the Moulin-les-Metz railway station. The Handley Pages were used on several more individual night missions before the wing was disbanded in April 1917.[23]

Poor weather and limited availability of aircraft hampered the performance of the Allied strategic offensive from Luxeuil and Ochey. Though one author indicates the campaign was "remarkably successful," another contends that the "low operational effectiveness . . . only supports the case against the

Table 12

Groupe de Bombardement 4, Strategic Night Bombardment in Conjunction with RNAS No. 3 (N) Wing October–December 1916

Date	*Escadrille*	Number of Sorties	Weight of Bombs (kg)	Target
October				
9/10	F 123	1	200	Mülheim rail depot
10/11	F 123	1	120	Stuttgart rail depot
11/12	F 29 F 123 BM 120	4 5 8	480 580 1790	Oberndorf factories
22/23	F 29 F 123 BM 120	4 4 4	520 220 1248	Hagendingen blast-furnaces
November				
10/11	F 29 & F 123 BM 120	4 4	480 960	Völkingen steel mills
11/12	F 29 & F 123 BM 120	8 3	780 792	Völkingen steel mills
23/24	?	4	360	Völkingen steel mills
December				
27/28	F 123 & BM 120	9	600	Factories and blast furnaces of Brebach, Bous, Durbach, Neunkirchen, Völkingen

Source: *Operations de Bombardement de Nuit Effectuees par l'Aviation de Bombardement,* October–December 1916, World War I Night Aviation Collection, SHAA. *Kilduff lists the target as the Dilligen blast furnaces in "History of Groupes de Bombardement 4 and 9," *Cross and Cockade Journal* (U.S.) 15, no. 1 (Spring 1974): 9.

raids ever having been attempted in the first place." Nonetheless, the latter concedes that regardless of the results, "bombing attacks on German cities were becoming a necessary feature of a popular [British] war policy." RNAS bombing operations continued from the Dunkirk aerodromes against heavily defended German positions along the occupied Flanders coast—Ostend, Zeebrugge, Bruges, and Blankenberghe.[24]

British Reorganization

The mobilization of No. 100 Squadron as the first RFC night bombing squadron in February 1917 likely resulted from No. 3 (N) Wing activities at Luxeuil. The RFC had sought the disbanding of the RNAS wing on the grounds that bombardment operations against Germany were not the responsibility of naval aviation. Yet the RFC was forced to organize a unit whose utility, from the official RFC perspective, was at best questionable. For without such a night bombing unit, the RFC might well have had difficulty in convincing the home government of its capacity to successfully replace No. 3 (N) Wing.[25]

Having suffered through three months of daylight attacks, the British public was outraged by the country's seeming defenselessness against night raiders. Reorganization of home defense swiftly followed, leading to an improvement in capabilities especially for the region around London. Additionally, politicians, press, and the public clamored for reprisals against German cities.[26]

The British selected Ochey aerodrome in October 1917 as the home field for the 41st Wing, RFC, their answer to the Gotha bombings. At Ochey, No. 100 Squadron was joined by 'A' Naval Squadron, flying the Handley Page bomber. To these night squadrons was added No. 55 Squadron, flying the DH4 daylight bomber. The complementary nature of the wing, with a day unit and short- and long-distance night elements, made the reprisal effort extremely flexible. Unfortunately only 14 missions (five by night) were executed by the end of the 1917; adverse weather conditions prevented more extensive operations. Rather appropriately, the RFC strategic bombardment of German cities met with the same meager results that had characterized No. 3 (N) Wing strategic operations from the same airfield six months earlier.[27]

By this stage of the war, bombardment aviation was on the increase, regardless of actual operational results. On 22 December 1917 Maj Gen Hugh M. Trenchard announced British plans for a strategic bombardment force to strike at German industrial centers (the eastern limit of operations being roughly Cologne-Frankfurt-Stuttgart) during a meeting

with Maj Gen Maurice Duval, chef du Service Aéronautique, and an American representative. General Duval explained that France considered the blockade of raw material movement out of the Briey Basin most crucial. France would continue bombing the rail lines in an effort to hamper German war production. Duval also reminded Trenchard that reprisals against French cities was easier than Allied attacks on German cities. France clearly did not want to bear the brunt of German reprisals caused by indiscriminate British activity.[28]

RFC plans called for the expansion of night bombing by eight additional squadrons. Work began on airfields at Xaffevillers and Roville, France, to accommodate the increase. In February 1918, 41st Wing came under VIII Brigade command, later becoming part of the Independent Forces, Royal Air Force (RAF).[29]

The British strategic bombers of VIII Brigade continued to strike the industrial centers of western Germany in the early months of 1918. Once the Ludendorff offensive began in March 1918, the squadrons began bombing tactical targets (especially the rail supply lines to the German front) in support of the British ground forces. The planes were able to resume strategic operations once the offensive stalled in mid-May 1918. Two day-bombing units were added to VIII Brigade during the offensive. With the increasing mix of day and night units, a reorganization was necessary to maintain efficiency. The 41st Wing controlled the day squadrons, and the newly formed 83d Wing took charge of the night elements. Further recognition came with the title Independent Forces, RAF on 6 June 1918.[30]

Table 13 compares the activity of British day and night bombardment units between 1 January and 30 June 1918. Only three squadrons, Nos. 55, 100, and 216 were specifically apportioned for strategic operations. Yet most of their missions during the period were against targets in support of units resisting the German spring offensives (table 14). Not surprisingly, the British bomber force was most active in March.

Of interest is the operational capability of the short-range night bombers that carried out operations only two fewer days per month on average than their daytime compatriots. Among the night aircraft, the limited operations of Handley Page

Table 13

Comparison of British Day and Night Bombardment Squadron Activity, 1 January–21 May 1918

Day Bombardment (DH 4 and DH 9)										
Squadron Number	**18**	**25**	**27**	**49**	**55**	**57**	**205**	**206**	**211**	**Total**
Number of days in commission	137	138	137	70	129	139	74	49	37	910
Number of days of activity										
January	8	7	7	0	2	14	0	0	0	38
February	7	3	11	0	4	11	0	0	0	36
March	24	17	22	9	10	18	19	0	0	119
April	19	6	7	7	3	7	9	10	10	78
May	14	9	11	8	7	14	11	12	12	98
Total	72	42	58	24	26	64	39	22	22	369
Avg/month	15.8	9.1	12.7	10.3	6.0	13.8	15.8	13.5	12.2	12.2
Total tons dropped	68.3	37.6	54.6	29.6	27.2	76.0	61.5	26.4	12.0	393
Avg/month	14.9	8.2	11.9	12.7	6.3	16.4	24.9	16.2	9.8	13.0
Avg/day of activity	0.95	0.09	0.94	1.23	1.05	1.19	1.58	1.20	0.55	1.07

Table 13 (con't)

Comparison of British Day and Night Bombardment Squadron Activity, 1 January–21 May 1918

Night Bombardment (DH2b and Handley Page)										
Squadron Number	**58**	**83**	**100**	**101**	**102**	**148**	**Total**	**214**	**216**	**Total**
Number of days in commission	88	60	135	140	138	3	564	50	118	164
Number of days of activity										
January	0	0	7	9	8	0	24	0	2	2
February	3	0	5	7	12	0	27	0	2	2
March	18	9	3	15	13	0	58	1	2	3
April	9	8	4	9	10	0	40	2	3	5
May	9	8	3	11	10	2	43	8	1	9
Total	39	25	22	51	53	2	192	11	10	21
Avg/month	13.3	12.5	4.9	10.9	11.5	20.0	15.8	6.6	2.5	3.8
Total tons dropped	67.1	45.0	22.8	111.1	111.1	76.0	358.5	33.1	9.6	42.7
Avg/month	22.9	22.5	5.1	23.8	24.2	16.4	19.1	19.8	2.7	7.6
Avg/day of activity	1.72	1.80	1.04	2.18	2.10	1.19	1.87	3.01	0.96	2.03

Squadrons 103 and 207 are not included, as they made only one raid each.
British long tons (1 ton = 2,240 pounds)

Source: Adapted from Table No. 4, "Statistical Analysis of Aerial Bombardment," Report No. 110, Statistics Branch - General Staff, War Department, 7 November 1918; Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919,* National Archives Microfilm Publications, no. 990 (Washington, D.C.: National Archives and Records Administration, 1974), vol. B-7, 115.

Table 14

British Bombardment Objectives, 1 January–19 May 1918

Day Bombardment (DH 4 and DH 9)										
Squadron Number	**18**	**25**	**27**	**49**	**55****	**57**	**103**	**205**	**206**	**211**
First raid Last raid	Jan 3 May 19	Jan 1 May 18	Jan 3 May 19	Mar 11 May 19	Jan 14 May 22	Jan 1 May 19	May 19 May 19	Mar 7 May 19	Apr 1 May 19	Apr 11 May 19
Number of towns with objectives	*	*	*	24	17	*	1	14	18	14
Objectives										
Railway stations	5	19	26	5	18	3	1	2	3	3
Railway sidings	3	2	5	1	11	8	0	10	1	0
Docks and Canals	0	0	0	3	1	0	0	0	0	9
Factories	0	0	0	0	12	0	0	0	0	0
Dumps	6	3	1	14	0	17	0	4	2	3
Aerodromes	7	6	7	2	0	4	0	16	9	2
Billets	12	3	5	1	8	5	0	6	0	1
Unknown	93	19	42	15	0	53	0	8	14	12

Table 14 (con't)

British Bombardment Objectives, 1 January–19 May 1918

Night Bombardment (FE2b and Handley Page)										
Squadron Number	**58**	**83**	**100****	**101**	**102**	**148**	**207**	**214**	**216****	**Total Day and Night**
First raid Last raid	Feb 21 May 18	Mar 21 May 18	Jan 1 May 17	Jan 3 May 21	Jan 2 May 18	May 17 May 18	Mar 31 Mar 31	Mar 31 May 18	Jan 21 May 17	
Number of towns with objectives	33	15	22	*	*	2	2	9	10	–
Objectives										
Railway stations	21	2	22	19	1	2	1	5	8	166
Railway sidings	5	0	13	0	2	0	0	0	7	68
Bridges	0	0	2	2	7	0	0	0	1	12
Docks and Canals	0	0	0	0	0	0	1	10	1	25
Factories	0	0	5	1	0	0	0	2	4	24
Dumps	2	5	0	9	0	0	0	0	0	66
Aerodromes	11	0	3	28	20	0	0	0	0	115
Billets	3	1	0	2	12	0	0	0	0	59
Unknown	12	20	2	48	60	2	0	3	0	403

*Activities widely dispersed
**41st Wing strategic bombers

Source: Adapted from Table No. 5, "Statistical Analysis of Aerial Bombardments," Report No. 110, Statistics Branch - General Staff, War Department, 7 November 1918; Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919*, National Archives Microfilm Publications, no. 990 (Washington, D.C.: National Archives and Records Administration, 1974), vol. B-7, 116.

squadrons is clearly evident. Had larger numbers of the planes been available, their heavy bomb load, which was more than five times that of the FE2b, would certainly have helped in the effort to hamper German resupply. During this period, no more than two of the large aircraft in No. 216 Squadron participated in specific missions.[31]

Night bombardment units flew only one-third of all 41st Wing/ VIII Brigade missions up to the creation of the Independent Force. Yet the loss of night fliers was proportionally greater than that of day bombers. The Canadian official historian argues that difficulty in night navigation and the lack of an effective German daylight defense were the main factors in such a disparity between British day and night strategic bombardment aviation.[32]

From the time the Germans were put on the defensive in July 1918 until the end of the war, the Independent Force was able to concentrate on strategic bombardment. By the end of August, the force had expanded to nine squadrons, of which five were night bomb squadrons. General Trenchard decided "to attack as many large industrial centers as possible instead of concentrating the Independent Force on the most important." He felt that the moral effect would be greater, as no inhabitants of western Germany could feel immune from attack. Additionally, the German military would have to build up and maintain more home defense, thereby taking men and material away from the front. It was further decided that when conditions prevented distant strikes, attacks on railroads would receive priority. Next on the list were blast furnaces since they were "easy to find at night."[33]

In September and October 1918, Independent Force bombers supported the French and American ground offensives by bombing railway targets. Weather often hampered strategic operations in the closing months of the war. When long-distance missions were undertaken, the day bombers had to fend off stiff German fighter opposition and heavy antiaircraft fire. As an example of the capability of German night defenses, four Handley Page bombers were lost on a raid against Cologne. An estimated 173 searchlights were involved and over 16,000 AAA rounds were fired.[34]

Briey Basin

The French continued strategic operations against targets in the Briey Basin after the demise of No. 3 (N) Wing in early 1917. As an estimated 75 percent of Germany's iron ore was being mined in the Saar-Lorraine-Luxembourg region, the strategic operation deserved high priority. Additional estimates declared that 10,000 railroad cars moved through the basin daily. These cars funneled through three critical choke-points—Thionville, Bettembourg, and Metz, all in France—which were regularly targeted. Blast furnaces and steel mills were also important targets in the Briey Basin.[35]

The basin remained the strategic concern of French bombardment aviation into 1918. With the exception of GB 8, all night bombing groups, under Escadre 11, continued to pound the region until the German March offensives diverted their attention. Soon afterwards, strategic operations in Lorraine resumed their preoffensive intensity. Two factors led the French air service to concentrate strategic aviation against the Briey Basin during the last two years of the war.[36]

First, the Lorraine-Luxembourg iron-ore region was the only important center of German war industry that could effectively be targeted by the short-range Voisin pushers (the majority of French bombers for most of the war). Fear of German reprisal against French civilians should the French bomb German municipalities was just as important. French short-range bombers could not effectively carry out retaliation against German cities. Hence it made sense not to get into a "war of reprisal."

When the Inter-Allied Independent Air Force (IAIAF) was established on 3 October 1918, the war remained "business as usual." The Independent Forces RAF bombed interior German industrial centers, French GBs 2 and 18 struck the Briey Basin. Table 15 shows the increasing importance of strategic strikes against Germany. In a memorandum sent by Marshal Ferinand Foch, the commander in chief of the Allied Armies, to French President Georges Clemenceau on 13 September 1918, Foch made it clear that the proposed raids on German population centers by the IAIAF were not reprisals, but "like poison gas [were] a means of warfare which was first used by

Table 15

British and French Strategic Bombardment of Germany

Year	Day Missions	Night Missions	Estimated Number Bombs
1915	44	7	940
1916	21	75	917
1917	45	130	5,234
1918	119	234	7,117
Total	229	446	14,208

Source: German official figures listed in H. A. Jones, *War in the Air*, vol. 6 (Oxford: Clarendon Press, 1928), 152.

the enemy and which we are therefore forced to use in our turn." Foch then reiterated that the "best way of affecting the German metal industry at the *present date*" was at "the very source of production, i.e. *localized supplies of* iron *ore*, the transport of which takes place via certain *obligatory* routes [emphasis in original]."[37]

In view of maximizing efficiency, Marshal Foch declared that only long-distance bombing aircraft should be incorporated into the IAIAF. Once sufficient heavy bombers were in place, the Briey Basin iron district would no longer be targeted by the force. "These raids will be carried out by French aeroplanes having an average load [the Voisin 10 and Bréguet 14 B 2 for instance]." The French were clearly unwilling to relinquish control of bombing activities in the region, especially to the British. For two years, French bombers had attempted to blockade the basin by destruction of the rail net. Minimizing collateral damage to territory the French considered their own had remained a constant concern. At the time of the armistice, Escadre 11 had 245 bombers committed against the Briey Basin, an increase of 100 airplanes since 1 March 1918. However, the number of F 50 and C 23 heavy bombers still remained limited at the end of the war. With the formation of the IAIAF in October 1918, Allied strategic bombardment changed in name only.[38]

US Assistance

The United States was anxious to assist its Allies in the air war. Two months after declaring war on Germany, an aeronautical commission headed by Maj Raynal Bolling was sent to Europe to gain a better understanding of Allied requirements for American aviation. The final report of the commission, filed on 15 August 1917, contained interesting ideas regarding the use of night bombardment aviation. Major Bolling declared that as there was "practically no effective means of preventing night-bombing . . . [c]ould night bombing be conducted on a sufficiently great scale, there seems good reason to believe that it might determine the whole outcome of military operations."[39]

One author contends that Bolling was overly influenced by then Lt Col William "Billy" Mitchell's concept of airpower, the major having talked with Mitchell in Paris. Upon visiting a French night bombardment group, Mitchell found great esprit among its crew members. They insisted that with enough equipment "there would be nothing left of Germany." Bolling suggested in his report that more than one-third of all American aircraft American aircraft production should be night bombers. Gen Benjamin Foulois, chief of the Air Service, believed that Germany was preparing to secure "air supremacy in night bombing" in 1918. He surmised that the solution to the problem was simply "to build more night bombing squadrons than the enemy and carry out a greater offensive bombing campaign against him."[40]

Preparations for a night bomber arm within the United States Air Service (USAS) began when Handley Page 0/400 drawings were received by the US War Department in August 1917. The Caproni Ca 5 was believed superior to the Handley Page, but drawings were not readily available. Additionally, Glenn Martin began designing and building a bomber that ultimately proved faster and higher flying than either of the other two models. Unfortunately, the Martin bomber was not in full production at the time of the armistice.[41]

As American production of Handley Page aircraft was proceeding slowly, General Foulois tried to obtain 12 French Voisin aircraft to establish a USAS night bombardment

squadron. Six were delivered by the end of March 1918, but their disposition is uncertain. Adding further to the night bombardment dilemma was the reinstatement in early June 1918 of the 260-Squadron Plan, which was originally formulated in September 1917.[42]

The plan called for the formation of 60 night bombardment squadrons, with an estimated need for 21 replacement squadrons to maintain a full complement of service squadrons. To improve coordination of many different activities, the USAS organized the Night Bombardment Section on 28 June 1918. Yet for all the effort, only one bombardment squadron, the 155th, arrived at the front on 9 November 1918, too late to carry out combat missions.[43]

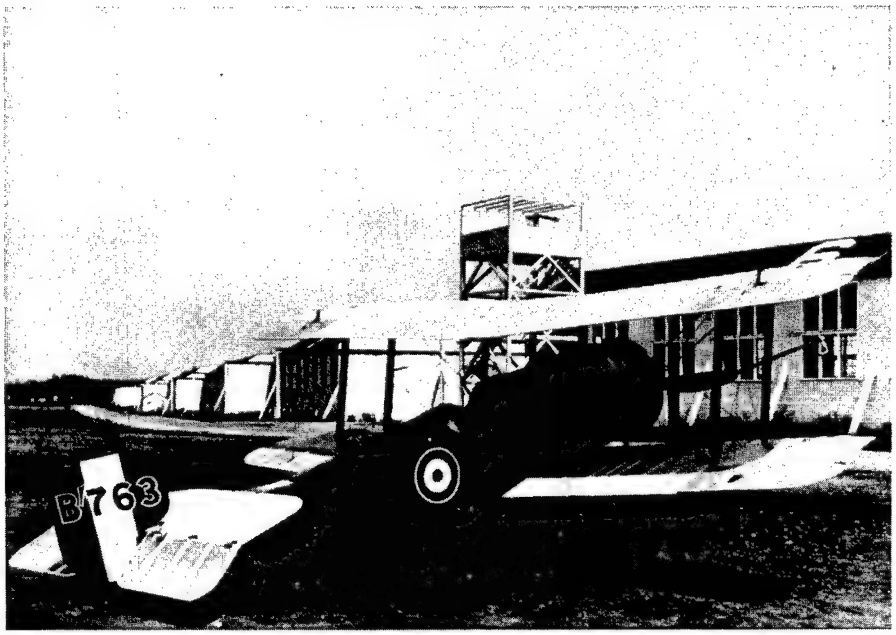
The United States did carry out a strategic night bombardment during the First World War through the US Naval Aviation Forces Northern Bombing Group. Organized in April 1918, the Northern Bombing Group was the US's answer to the RNAS effort against the submarine bases in German-occupied Flanders. Initial requirements called for establishment of six night bombardment squadrons using either Handley Page or Caproni heavy bombers; additionally plans called for the formation of six day squadrons equipped with DH 9 or Bristol aircraft. Naval aviators manned the night squadrons while Marine aviators staffed the day units.[44]

Unfortunately the Caproni Ca 5s provided to the Northern Bombing Group Night Wing were equipped with faulty Fiat motors; only eight of the 17 Ca 5s survived the ferry flight from Italy to the night wing base at Saint Inglevert. On 15 August 1918 the night wing carried out its only operation of the war with one Caproni. The airplanes simply could not be kept in usable condition. Nonetheless several naval aviators performed night missions as observers with RAF No. 214 Squadron, flying Handley Page bombers. The United States failed in its attempts to join the Allies in strategic bombing.[45]

Conclusion

The French were constrained by geography and aircraft to the strategic bombardment of the Briey Basin. Limited capability bombers that were forced to fly at night could carry

DeHaviland



Bristol Scout

out an extended campaign nowhere else. Even had extended-range bombers been available early in the war strategic targeting would likely have remained the same. The basic problem was that French cities were vulnerable to German reprisal. Paris was little more than 50 miles from the front. France would have lost a war of "city busting." In this situation, the railways and industry of the Briey Basin appeared to be the only strategic option for France.

Great Britain had two distinct opinions regarding strategic bombardment. The RNAS minority opinion pressed for strategic targeting of German steel production as well as of naval related objectives along the Belgian coast. The RFC believed its bombing assets were best used in a tactical role over the battle zone. The RFC was forced into accepting a strategic role because of RNAS strategic activity.

Only grudgingly did the RFC incorporate the Handley Page heavy bomber into its inventory. The French feared the British would use its strategic capacity for indiscriminate bombing of German targets. Yet fully 40 percent of Independent Forces RAF bombs (220 of 543 tons) were directed at German airfields to damage and subdue German night bombing and fighter squadrons. These were usually the target of the FE2b-equipped night bomber squadrons.

Additionally railway targets constituted a main objective of the British strategic campaign. The bombing of industrial targets in German cities was simply not as widespread as the French had feared. Therefore on closer examination, the French and British strategic campaigns were not as disparate as they might appear.[46]

German airship and airplane raids against England proved ineffective in reducing British war resolve. Were the campaigns wasteful expenditures of limited German resources? Certainly the airship program was extremely expensive for the results achieved. However the number of airplanes flying against England remained a minority of the German bomber force. Additionally the bombers of Bogohl 3 and Rfa 501 were often used for tactical missions, especially during the spring 1918 offensives. It seems unlikely that their exclusive use for tactical bombing operations in 1917 and 1918 would have made a greater impact on the outcome of the war.[47]

The British were forced to invest heavily in defending their island. One author contends that the equivalent of 10 full-strength fighter units and two or three short-range bombardment squadrons (that could have been formed and used on the Western Front) were tied up in home defense duties. Germany, already outnumbered on the front, could have ill-afforded such an addition to the enemy camp. Thus the decision to carry out the strategic bombardment campaign against England was not totally in error.[48]

World War I strategic night bombardment evolved from daring individual missions in converted observation airplanes into highly developed operations using large aircraft capable of carrying a heavy bomb load into the enemy's heartland. Urban civilian populations far from the front could now have a first-hand view of the horrors of war.

Notes

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4. Douglas H. Robinson, *The Zeppelin in Combat: A History of the German Naval Airship Division, 1912–1918*, 3d ed. (Seattle: University of Washington Press, 1980), 57–64; Christopher Cole and E. F. Cheesman, *The Air Defence of Britain 1914–1918* (London: Putnam, 1984), 24–25, 448.

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6. Robinson, 189; Cole and Cheesman, 172, 448.

7. Cole and Cheesman, 199–200, 229; Robinson, 331, 337–39.

8. Georg P. Neumann, *The German Air Force in the Great War*, trans. J. E. Gurdon (London: Hodder and Stoughton, [1920]), 178–79.

9. G. W. Haddow and Peter M. Grosz, *The German Giants: The Story of the R-Planes, 1914–19* (London: Putnam, 1963), 6; Coleman and Cheesman, 308.

10. Haddow and Grosz, xii, 11; Cole and Cheesman, 308.

11. Haddow and Grosz, 12.

12. Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 5 (Oxford: Clarendon Press, 1928), 60; Cole and Cheesman, 200–201.

13. White, 36–39.

14. Ibid., 35; Raymond H. Fredette, *The Sky on Fire: The First Battle of Britain 1917-1918, and the Birth of the Royal Air Force* (1976; reprint, Washington, D.C.: Smithsonian Institution Press, 1991), 38.

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Chapter 5

The Foundations of Night Fighting

Aerial combat proved to be the most frustrating of all night flying attempted during the First World War. Night bombers flew to their objective, unloaded their cargo, and returned home. Night reconnaissance aircrews similarly flew over a designated route to expose hostile activities. But night pursuit aviators had no set itinerary—they patrolled the skies looking for an illusory enemy whose black-painted aircraft blended into the darkness. Sometimes the hunter saw his quarry momentarily illuminated by searchlight; other times the prey was but a fleeting shadow against the lighted moon; occasionally brightly colored engine exhaust gases were the only indication that the game was nearby. Most often the hunter came home without firing a shot. Yet by the end of the war, night pursuit pilots were often successful at stalking their quarry.

Paris and London were of vital importance to both the Allies and Germany. German bombardment of the capital cities would bring the war right to the halls of government. Additionally many civil and military authorities feared that such bombings would damage civilian morale, thereby reducing popular confidence in national leadership. The capitals had to be defended day and night by all possible means; pursuit aviation was part of that defense. From the opening days of the war, the French air service dedicated large numbers of airplanes to the defense of Paris. By the summer of 1916, over 100 airplanes were performing such duty. These planes maintained a constant daylight patrol against German incursions and supplemented searchlight and antiaircraft defenses when German airships threatened the city by night. During the summer of 1916, six aviators and their Nieuport Bebe aircraft stood by on night alerts. The remaining Paris defense pilots were expected to answer a call as soon as possible. Aviators flew over the city, which was divided into three sectors for night defense, at designated altitudes between 1,200 and 4,000 meters. They met with little success.[1]

British Home Defense

The British expected a massive Zeppelin attack against London soon after the outbreak of hostilities. Airplanes were quickly assigned to supplement the few antiaircraft guns available for home defense, even though the Admiralty and War Office had little faith in their capacity for night interception. Nevertheless on the night of 5–6 September 1914, Claude Graham-White and Richard Gates flew a Farman on the first nighttime Zeppelin patrol over London. They returned to Hendon after searching for the phantom airship for over an hour.[2]

Two RFC crews assigned to Joyce Green Field ventured into the blustery night of 19–20 January 1915 to oppose the first genuine Zeppelin intrusion against England. Both airplanes experienced engine problems and made forced landings without sighting the airships. By the end of January 1915, RNAS coastal airfields each had three airplanes on alert status while the RFC stations east of Farnborough maintained two airplanes for anti-Zeppelin missions. Emergency night landing fields were soon established throughout London to provide a safeguard in the event of engine failure over the city.[3]

Interservice bickering between the RFC and RNAS over home defense responsibilities limited the effectiveness of night airplane operations during much of 1915. Even the question of airplane armament remained unsettled. RNAS Flight Sub-lieutenant R. A. J. Warneford downed a Zeppelin on the continent in the early morning hours of 7 June 1915 by dropping bombs on the airship. While some British authorities henceforth discounted the use of machine guns and incendiary bullets against airships, others were not so sure. When the Board of Invention and Research Sub-committee for Aeroplanes filed its report on night flying in September 1915, board members complained that night navigation and landing facilities remained inadequate—a year after the war had begun. Research and experimentation with British night pursuit continued at a fast pace but produced little tangible results during 1915. By the end of the year, the RFC had but a total of 20 aircraft, mainly of the BE2c type, on alert at 10 airfields (two per field) across southern England. The only

results from 115 night home defense sorties flown during the first full year of fighting were negative. Three British aviators were killed and 18 aircraft damaged.[4]

In March 1916 British home defense reorganization called for the establishment of 10 squadrons; only five squadrons (Nos. 33, 36, 38, 39, and 51) were in existence when the Home Defense Wing came into being in June. During the summer of 1916, a major change in night employment occurred. Formerly home defense pilots patrolled only in the immediate vicinity of their airfield. New arrangements called for a barrage line of searchlights and airplanes running near the British east coast from Dover to Edinburgh, with home defense airfields roughly 20 miles apart. Pilots would now patrol between stations in their hunt for enemy aircraft.

Along with the increasing efficiency of home defense organization and employment came a major advance in armament. Incendiary and explosive bullets brought within sight "the end of the Zeppelin as a raiding weapon." Additionally No. 11 Reserve Squadron, the primary night flying training unit, was transferred to the Home Defense Wing in August. The unique demands of home defense were finally being recognized.[5]

On the night of 2 September 1916, Lt William Leefe Robinson was flying his BE2c on patrol between Hornchurch and Joyce Green when he spotted German airship SLl l. Flying through the AAA barrage, Robinson emptied three drums of the new explosive and incendiary ammunition into the German ship. The airship quickly turned into a roaring inferno as it fell from the sky. Robinson won the Victoria Cross for this first victory against an enemy dirigible over England. Morale soared for the home defense pilots and British populace. Further victories followed in rapid succession during September and October. By the end of November, Germany temporarily halted airship operations against Great Britain.[6]

The RNAS claimed a secondary share of the home defense role during 1916 but seemingly carried out its duties with little enthusiasm. The Canadian official historian declares that:

> In the RNAS scheme of things, the home defense establishment was really coterminous with its night-flying training. In April 36 per cent of

> the 304 aeroplanes on active RNAS duty were being used for this combination of home defense and night-flying duties. By the end of the year the number of aeroplanes on such duties had increased only slightly; more significant, all but ten had been downgraded to the category of second-class aircraft. In other words, the Admiralty reordered priorities for its air service, the home aeroplane element lost most of its experienced pilots and its aircraft were allowed to become largely obsolescent.
>
> With the exception of a few veteran pilots retained for night flying, the RNAS used the home aeroplane organization as a graduate course for inexperienced pilots.[7]

The night training on the home front gave the RNAS a large pool of experienced pilots for duty on the continent.

In early 1917, with the British Isles now "safe" from Zeppelin attack, the RFC reduced home defense by conscripting pilots for No. 100 Squadron, the newly formed night-bomber unit. Presumably most of the personnel were more than happy at the opportunity to fly on the Western Front. Most home defense patrols were lonely solo affairs searching for an elusive, or often phantom, airship. As the Germans had sent but 42 airship missions against England during 29 months of fighting, anxious home defense pilots awaited notifications which often never came.[8]

Night Airplane Bombardment

Airships had proven to be a difficult target for night pursuit pilots during 1915 and 1916, and night dogfights between airplanes still appeared unfeasible. Yet night airplane bombardments had become routine by 1917, and searchlight and AAA defenses seemed impotent to stop them. In a chance encounter during the night of 11 February 1917, Leutnants Peter and Frowein of Feldfiliegerabteilung 12, flying a C-plane, succeeded in shooting down two French bombers as they returned to Malzeville aerodrome. Wingtip navigation lights gave away the location of the French planes and made them easy targets. Loitering over enemy night bomber aerodromes would become a favorite tactic of the First World War night fighter.[9]

The Germans formed kampfeinsitzerstaffeln in a fashion similar to the British home defense units. These staffeln of single-seat fighters originally defended Alsace and Lorraine

against French night bombers. With the extension of Allied bombardment into Germany during the final year of warfare, new units were organized further to the rear. The Jagdstaffeln increasingly were responsible for night fighting close to the front; Jasta 73 alone shot down seven Voisins between 20 August and 25 September 1918. Additionally two special squadrons (one army, one navy) of six C-planes each were formed in June 1918 for the express purpose of attacking Allied night bombers as they were landing at their aerodromes. German night fighters performed admirably during the closing stages of the war.[10]

French pilots made several bold night pursuit flights during the battle of the Somme in 1916, but French air service officials remained skeptical over the possibilities of night fighting. In the summer of 1917, Capitaine Henri Langevin, the commandant of Escadrille 313, began night pursuit flights on his own initiative by flying Nieuport 15-meter single-seat aircraft from Couderkque near Dunkirk. This effort appears to be the first systematic testing of fast fighter aircraft for night work by any of the belligerents during the First World War. Night fighting had been performed with fairly stable, slow-flying planes since military authorities believed that planes landing at high speed were likely to crash.[11]

Langevin began his experimental work on moonlit nights over the North Sea since German bombers used a water route along the coast to Dunkirk. He was able to spot Voisins from Escadrilles V 109 and V 116 returning from night missions. From above they were silhouetted by moonlight reflecting off the sea. The French aviator succeeded in locating a G-plane by this method while flying at an altitude of 3,200 meters during the early morning hours of 3 September 1917. Unfortunately the plane was lost to view when it passed over the coastline. The following night, Langevin spotted two more planes flying at roughly 3,000 meters. French AAA batteries began to score against the German bombers after realigning their barrage fire to this altitude.[12]

Initially Langevin recommended two-seaters for night pursuit work. He believed that an observer was critical for successful operations as the pilot was occupied with flying the plane. He also advocated a standing patrol over Dunkirk in

advance of anticipated German bomber activity. With further experience, Langevin refuted both concepts; fast single-seaters were needed to close quickly on enemy planes and standing patrols wore down both men and materiel. Commandant Felix Brocard, commander of Groupe de Combat 12, forwarded Langevin's report of 29 July 1917 to Général Duval with his endorsement. Interestingly Brocard argued that a practical solution might be the transfer of an existing night bombardment escadrille to night pursuit work. He apparently believed night flying experience was more valuable than acrobatic skills; nighttime dogfights did not exist in the same sense as day combats between pursuit planes.[13]

The French air service began night instruction with Nieuport aircraft at its training center at Avord as Escadrille 313 expanded its night activities. GQG ordered the escadrille to take up night pursuit on a full-time basis in late September. Delays in adapting the flight's Nieuport and Sopwith 1½ Strutters for night work kept the escadrille out of action during the most intense period of German night bombing of Dunkirk. The unit was ready for action at the end of October 1917, but enemy bombing declined as the battle of Flanders came to an end.[14]

Apparently the unit maintained single-, two-, and three-seater aircraft for three distinct night missions during 1918. The single-seaters provided point defense over Dunkirk and Calais; the two-seaters flew patrols between the two cities; while the three-seaters were used to attack German bombers over the enemy's aerodromes. During the spring offensives, the unit also performed night reconnaissance missions.[15]

The French air service organized a detachment at Pars-les-Romilly for night fighting experimentation in mid-September 1918. Just three weeks before the armistice, the detachment became the Centre d' Instruction pour l 'Aviation de Chasse de Nuit. The center assured liaison with the antiaircraft school, instructed pilots destined for night pursuit units, developed night fighter tactics, and assisted in antiaircraft training and experimentation.

Coordinated training with antiaircraft units had begun by July 1918 (at the latest). Such instruction usually featured ground searchlights attempting to illuminate a decoy Voisin

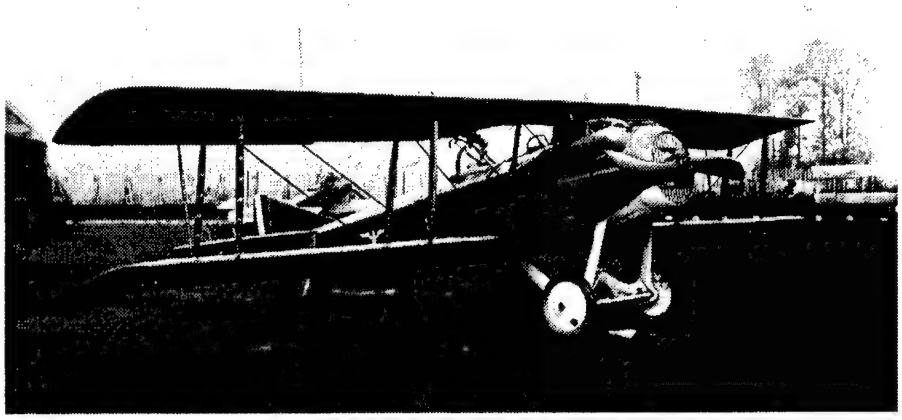
bomber, followed by aerial intercept by Nieuport, Spad, or Bréguet fighters.[16]

Unfortunately the instruction center experienced a critical shortage of planes equipped for night flying. Capitaine Jacques de Lesseps, the school commander, even requested that Spad pilots begin training at the Centre d'Instruction de l'Aviation de Chasse et de Bombardement (CIACB) at la Perthe, but the CIACB also had no night-ready aircraft. Presumably no night pursuit pilots completed the program of instruction at Par-les-Romilly before the end of the war. The school was finally closed in February 1919. At the time, it had 10 Spad 7s, five Bréguet 14 A 2s, three Nieuport 120s, three Voisin Renaults, and one Voisin Peugeot aircraft—a case of too little too late.[17]

The RFC had been hesitant to try fast fighters for night pursuit work. However, on the night of 3 September 1917, Sopwith Camels were used by three pilots from No. 44 (Home Defence) Squadron for the first time against the German G-planes attacking London. Two RFC pilots on the continent flew Camels the same night. Maj Gen E. B. Ashmore, the commander of British home defense, considered the accomplishment "perhaps the most important event in the history of air defense." By the end of the year, Camels were being modified for home defense work along with SE5a and Bristol fighters.[18]

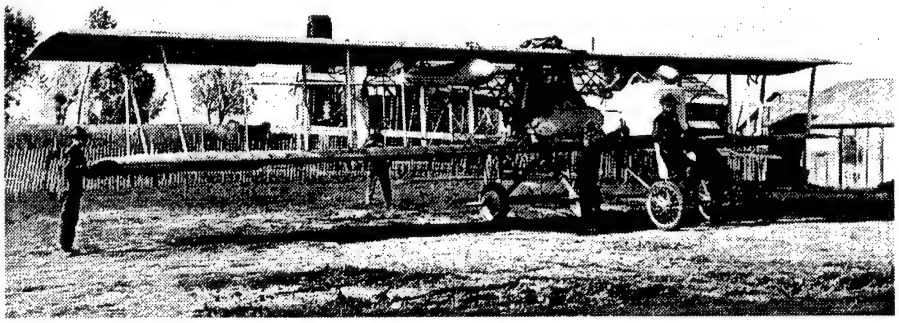
No. 44 Squadron Camels later were used to form part of No. 151 Squadron, the first British night pursuit unit to go to France. The late date of formation—12 June 1918—is rather surprising since the Germans had been carrying out night bombardment of British rear areas for many months. Nevertheless No. 151 Squadron "very nearly exterminated the Boche night bombers of the 1st and 3rd Army fronts," tallying at least 25 victories. No. 152 Squadron was sent to France in October 1918 but was barely operating when the armistice came. Another squadron was preparing to leave England by mid-November.[19]

The United States had high hopes for night pursuit in the closing weeks of the war. Plans were developed for the training of 300 night pursuit pilots. The 185th Aero Squadron was formed in early October 1918 for night fighting and equipped



Spad

with Sopwith Camels. Maj Harold Hartney, commanding the First Pursuit Group, decided to learn about night fighting through first-hand experience. On the night of 22 October, he encountered a G-plane at 12,000 feet. Engine exhaust flames gave away the bomber's location. Being unaccustomed to night flying, the aviator nearly rammed the German bomber, then stalled his machine and fell out of position. After recovering, Hartney succeeded in firing on the Gotha, but the bomber continued to fly. In the excitement of the moment, the major had switched off his engine and was forced to give up



Voisin

the chase. Yet he apparently succeeded in crippling the bomber. A G-plane full of bullet holes was found on the ground not far from the area of Hartney's encounter. This would be the 185th's only victory.[20]

Night Pursuit

Night pursuit proved most successful when fighter aircraft and ground searchlight defenses performed coordinated actions. Searchlights were of great importance in locating enemy bombers since night pursuit pilots could rarely locate other aircraft at distances beyond 700 meters even in bright moonlight. On dark nights identification was reduced to one hundred meters or less and was usually limited to spotting the glowing engine exhaust gases. Even when the searchlights failed to illuminate hostile aircraft, they provided the night fighter with a smaller search area.[21]

Additionally, advanced listening posts near the front provided early warning, thereby negating the need for standing patrols. Information concerning hostile aircraft crossing the lines was telephoned to searchlight and night pursuit locations. Such coordinated defenses increased night fighter efficiency. Because of the difficulties in locating aircraft, night pursuit pilots also needed to study and recognize aircraft by their unique silhouettes; friendly bombers returning from across the lines might otherwise be mistaken.[22]

By the end of the First World War, night bombers could no longer disregard the threat of pursuit aviation. The British were the most successful at night interception. With years of experience in home defense, the RAF pilots of No. 151 Squadron proved their skills in the darkened skies over northern France. Similarly, the aerial defenders of Germany took an increasing toll against French and British night bombers. Night pursuit could indeed no longer be overlooked.

Notes

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Chapter 6

Night Observation and Reconnaissance

In the opening weeks of the First World War, aircrews darted back and forth across the skies of Flanders and northeastern France to discover the intentions of enemy ground forces. Airplanes had one mission—reconnaissance. While many, if not most, military leaders regarded the airplane as little more than a supplement to cavalry, early successes led to acceptance of the airplane as an independent information gatherer. Only aircraft could provide timely reconnaissance across such a broad, fluid front. Yet no night reconnaissance missions were flown in 1914 or for that matter for most of the war. This is the great paradox of World War I night flying: while reconnaissance was the perceived duty of aviation, night observation was one of the last organized functions to appear as a specialized task during the First World War. Why was this true?

The advent of trench warfare brought an abrupt end to cavalry's contributions on the Western Front. Military leaders were now forced to depend on aviation for intelligence of enemy activities behind the lines. At the same time, the need for immediate knowledge of enemy operations subsided. Face to face on a heavily defended front bounded by impassible geographical features, there was no possibility of being quickly outflanked by an unseen opponent. In addition to the ongoing daylight reconnaissance, airplanes began to make dusk and dawn patrols to determine changes made under cover of darkness. Therefore, daylight airplane observations provided adequate intelligence gathering with one very important addition.

Balloon Reconnaissance

The captive balloon, clearly the oldest method of aerial intelligence gathering, reappeared behind the battlefront. Although the Allies considered the balloon obsolete for military use in 1914, the Germans maintained a usable inventory of

Drachens when hostilities erupted. Soon afterwards the French engineer Albert Caquot developed a balloon superior to the Drachen for Allied use. These balloons provided stable platforms for observation across the trench lines. From several thousand feet in the air, balloon observers could watch activity up to 15 miles behind the lines and provide real time information to ground forces through the use of telegraph or telephone.[1]

Balloons were also easily employed at night. Though many details were obscured by darkness, observers nevertheless were able to determine the limits of an enemy attack, report infantry signals during artillery barrage fire, and report enemy marker signals for hostile bombardment aircraft. The observation balloon was in fact so useful that opposing aircraft and artillery continually sought its demise.

In less than nine months of operation, 35 companies of the USAS Balloon Section tallied 3,111 hours of frontline observation, including night work. The section was first commanded by Col Frank P. Lahm, the winner of the 1906 James Gordon Bennett balloon competition. The combined system of captive balloons with their limited night capability and daylight airplane reconnaissance provided adequate intelligence gathering during the period of static warfare—specific night aircraft reconnaissance was not needed.[2]

Airship Intelligence Gathering

For much of the First World War the airship was used for intelligence gathering at sea. The first operational British aircraft of the war was the nonrigid Parseval airship No. 4, which conducted a patrol at the mouth of the Thames River on the night of 5–6 August 1914. British blimps were to fly more than 86,000 hours in the course of the war. Owing to their lack of endurance, the blimps could provide only short-range fleet support, convoy escort, and submarine patrols. Additionally, due to the failure of the British rigid airship program, aerial convoy escort duty along the dangerous western approaches was never adequately filled.[3]

German airships likewise performed in a reconnaissance role over the North Sea. As early as 1908, some German naval

officials believed that the airship would make a fine strategic scout, especially if Germany were blockaded. In the last year of the war, routine night reconnaissance flights were carried out toward the coast of Norway and to within 50 miles of the British coast. However the airships, flying at an altitude of 13,000 feet, garnered little usable information on these patrols. Fear of British airplanes evidently prevented the vulnerable German airships from flying at lower elevations.[4]

Although 971 reconnaissance flights were made over the North Sea during the course of the war, weather greatly hampered German airship operations. On the average, airships performed scouting missions on one day in four. The lack of regular reconnaissance led Douglas H. Robinson to conclude that German airships were improperly employed in North Sea scouting, especially late in the war. Strategic scouting missions along the western approaches, he argues, were feasible for the high-speed L70 class of airships. Clearly a coordinated effort with German submarines against Allied convoys during the period of unrestricted submarine warfare might well have had a decisive outcome.[5]

Night Aircraft Reconnaissance

Night bomber crews were expected to perform aerial reconnaissance during their missions over the lines. The French quickly recognized the importance of such duty.

> During the flight pilots and passengers will try to collect all possible information on the enemy, noting very exactly the time and the place. Upon return this information will be collected by the commander of the group, who will collate it and immediately make a report by telephone to army headquarters. A written version in two copies will then be sent to the Deuxieme Bureau and to the commander of the army's bombardment aviation.[6]

One of the earliest efforts to achieve systematic results occurred in 1916 during the Battle of the Somme. There, French night bombers made detailed observations after unloading their bombs. RFC airmen similarly undertook occasional night reconnaissance missions. During this period and in early 1917, GB 3 performed reconnaissance in con-

junction with bombing missions 15 to 50 kilometers behind the lines.[7]

Night artillery spotting was tested by both the French and Germans in late 1917. The French found that large targets were clearly visible in moonlight and offered the best opportunity for success. Attempts at ranging cannon fire against enemy batteries were less effective due to the difficulty in determining their exact coordinates in the darkness. During the night of 25 September 1917, a German airplane flying over the North Sea between Coxyde and Dunkirk directed fire from the infamous Lengenboom cannon via radio.[8]

Unable to prevent Allied day observation behind their lines, the Germans began moving troops and supplies at night. By masking their spring 1918 offensive preparations in this manner, the Germans successfully limited Allied information. French air service commanders reminded night bombers to be ever vigilant.

> Observers should not lose sight of the fact that the reconnaissance, which is part of each bombing mission, has a very great importance and that the information it provides can have broad consequences. In flying over a zone of attack, the bombardier with experience in night observation can sometimes tell at a glance in which sector the enemy will direct his efforts, simply by noting the differences in lighting and in rail activity.[9]

Yet the night bombers proved incapable of supplying enough information. Fully expecting a German offensive but unable to determine when or where enemy troops would go "over the top," Allied commanders called for a series of night reconnaissance flights.[10]

Not surprisingly, the British called on their old workhorse, the FE2b, with RFC airmen carrying out 13 night reconnaissance missions during the week of 13–18 March 1918. However, the Germans were prepared to meet these nighttime probes with the utmost discipline. One German aviator moving with ground forces toward the front noted in his diary the effect of flares dropped from these British scouts: "all traffic stops, and the troops crouch lifeless under the shelter of trees and houses. Nothing must be given away."[11]

Discipline was apparently so great that during the spring the British reported no use of artificial light for troop and

materiel movements within 15 miles of the front. Captive balloons were blind to German activities. Main roads were little used and some conjectured that "flaming onion" batteries firing phosphorescent shells were used to warn ground forces of the approach of hostile aircraft. Few lights were noticed in villages 40 miles from the front.[12]

The French likewise were performing night reconnaissance along their sector, the work being performed by the bombers of GB 8. Yet the Allies remained unable to gain a clear understanding of enemy intent. As the magnitude of the offensive became apparent, Escadre 11's night GBs (1 and 7) quickly shifted from Lorraine to the Groupe d'Armées du Nord (GAN) to supply added night reconnaissance capability.[13]

The Germans were able to make great progress during their March 1918 offensive in large part due to the night movement of troops. With the stalling of the offensive, surprisingly little was done by the Allies to establish a permanent night reconnaissance capability—even though the Allies could not hope to stop many more German offensives of the magnitude of the March assault without better preparation. For the two and one-half months between 25 April and 9 July 1918, Général Henri Pétain, général comandant en chef of French forces, lacked firm intelligence of German offensive movements and intentions. An order from the German army chief of staff reinforced the importance of night preparations. "Large troop movements and marches incidental to a change of billets will, as a rule, only take place at night. When troops on the march are taken by surprise at night by parachute flare dropped by a hostile airplane they will stop immediately and not move."[14]

As the situation became critical, Major Général Duval, on 3 July 1918, ordered the establishment of night reconnaissance detachments for all French armies as a means to improve information gathering. These detachments, composed of four planes, four pilots, and the necessary ground elements, were attached to army escadrilles for administrative and materiel support. Day observation pilots with night flying experience were drafted for rapid implementation of the night reconnaissance program. Additionally, the order required two observers, specializing in night observation, to be attached to

the individual armies. Five such detachments were established immediately, while night bombardment escadrilles (V 25, V 101, and V 118) provided provisional support as needed.[15]

Between 7 and 9 July 1918, French night reconnaissance units had great success, noting "abnormal illumination of railroad stations and railway, and numerous movements on the roads." This time the Allies knew the German offensive was not far distant and readied themselves to meet it. So critical was the information gained in the week before 15 July that Brig Gen Mason Patrick insisted the Allies "owed mainly to night reconnaissance" the knowledge of the attack on the Marne. Against a prepared opponent, the German offensive quickly stalled.[16]

Though limited in resources and planning, French night reconnaissance units performed quite admirably during the German advance in Champagne. Soon after the tide turned, Général Pétain reiterated his support for continued expansion of French aviation units specializing in night reconnaissance. Clearly the GBs could no longer be expected to execute two separate missions of critical importance. The need for comprehensive intelligence of enemy dispositions was simply too crucial to the continued success of the Allied advance that had begun with a counterattack on the heels of the German offensive. The seeds of night reconnaissance had begun to bear fruit.[17]

Impressed with the possibilities of such activity, Col William Mitchell, then chief of the Air Service, US First Army, directed the formation of the 1st Night Reconnaissance Flight. Three experienced day observation teams were selected to fill the new unit, as plans called for the rapid formation of an entire night reconnaissance squadron. Training immediately commenced at Vandey aerodrome under French direction, with the Bréguet 14 B2 selected for use. Additionally, at least one observation squadron, the 90th, attempted night flying in early August 1918. After several crashes the practice was apparently stopped.[18]

The 1st Night Reconnaissance Flight was absorbed into the 9th Aero Squadron on 2 September 1918. Twelve days later the squadron, flying from Amanty aerodrome, recorded its first successful operational night reconnaissance mission during

the Allied advance against the Saint Mihiel salient. Soon after the offensive, the unit moved to Vivancourt aerodrome. The 9th remained the sole USAS squadron specifically charged with night reconnaissance in the final two months of the war.[19]

Both French and American night reconnaissance units obtained their operations directives from the aeronautical commander at army level. Aircrews were then assigned specific routes to be flown to and from their objectives. Assignment of routes reduced the possibility of collision with other Allied night fliers. Additionally, a more complete reconnaissance of the sector could be achieved through set routes. Furthermore, strategic missions were usually carried out at night because of the decreased efficiency of enemy defenses. With the ability to penetrate further into hostile territory, night scouting was complementary to day activity—both were needed for a comprehensive picture of enemy activity.[20]

Visibility Problems

Visibility dictated the altitude employed during night reconnaissance. The ability of aircrews to locate objects on the ground depended on several factors, including the amount of moonlight and the clarity of the atmosphere. These factors influenced the capacity to distinguish even the most basic ground features. The British found that three components were essential for successful night scouting without artificial illumination. In addition to the absence of fog or mist near the ground, bright moonlight was important because it increased the contrast of ground features and cast distinct shadows that aided aerial identification. Finally, low flying simplified the observer's task and was a necessity for visual reconnaissance.[21]

Ground features were recognizable under full moonlight. Woods and forests appeared black, towns and villages looked gray, while less traveled open roads seemed whitish. Canals and waterways reflected moonlight, and were quite visible. Likewise railroads could be easily identified. Factories in operation cast a luminous glow that could be seen for miles. Finally, aerodromes and camps and bivouacs in open ground were identifiable under bright moonlight. Reconnaissance crews could cut down on

glare by flying with the moon shining from the back of the airplane.[22]

During periods of bright moonlight, detailed movements along broad open roads could be observed from a height of between 1,500 and 2,000 feet. Such activity could be identified up to 15 kilometers distant from the aircraft. When first detected, transports appeared as black dots, troop movements as oblong masses. Additionally, road movements during dry spells often resulted in a visible dust cloud. The billowing smoke emitted from steam engines made trains easy to recognize.[23]

During the half-moon phase, diminished light forced reconnaissance flights to an altitude of 1,500 feet and often to 1,000 feet for useful information gathering. Using only natural lighting, which often was presumed adequate for observation, an observer would frequently miss concealed movements. Half-moon periods resulted in more inaccurate reconnaissance than any other time of the month. Hence the parachute flare provided an important tool during such missions.[24]

Natural land features remained distinguishable in quarter-moon light, but were hardly recognizable on totally to dark nights. In fact, on moonless nights with overcast skies, fog, or mist, the challenge was simply for the scouts to remain on their intended course. Concealed movements on the ground were nearly impossible to detect. As an aid, special night maps showing only the most visible ground features—roads, rivers, towns, forests, and "permanent" lights—were used for night navigation during these periods. Obviously such conditions required the artificial light provided by parachute flares.[25]

Among the Allies, the Bourges flares were favored for target illumination. When ignited at a height of roughly 1,800 feet, these flares provided optimal ground illumination over an area ranging between one-quarter square mile to one square kilometer. These flares burned for approximately four minutes. Typically, for complete road reconnaissance several flares, dropped at intervals, produced an overlapping coverage that proved valuable in determining any abnormal activity. Additionally, reconnaissance observers found flares useful in illuminating such stationary objectives as railroad yards.[26]

Reorganization Efforts

The German army recognized the need for increased night reconnaissance to enhance its defensive posture soon after the Allied counteroffensive commenced in late July 1918. As with the French, German night scouting had been a secondary role for bombardment aircraft. However, German leaders believed that twin-engine G-planes were too noisy for the low-level missions required once the Allies began a concerted effort to carry out night movements. If the loudness of the engines betrayed the German presence, Allied troop and supply convoys could quickly disperse and take cover, thereby preventing effective reconnaissance.[27]

Occasional night flights by day observation units occurred throughout the summer, and by late summer Obersten Heeresleitung was seriously considering the organization of special night reconnaissance units. One major concern driving the use of night scouting was the need to locate Allied tank assembly areas. Tanks, if properly employed with infantry and artillery support, provided the Allies with weaponry capable of smashing through the German defenses. Hence the Germans needed to know the advance location of tanks. With such information, the Germans could target the tanks and hopefully destroy them before they could be used in a ground offensive.[28]

Meanwhile, the French were expanding their night reconnaissance capabilities. Since accurate information of German defenses would be critical for the impending Allied assault on the Saint Mihiel salient, more night reconnaissance units were needed. To resolve the shortage of night scouts, Général Pétain authorized the creation of a training center for special missions at Herbisse.[29]

Organization of the Center of Instruction for Long Distance Night Reconnaissance Aviation called for five instructors and between 12 and 15 trainees. Additionally, a night bombardment escadrille was to furnish 10 Voisin Renault aircraft. The training escadrille was designated V 200. The school had barely begun to function when its work was interrupted by the armistice. Six days later, the school at Herbisse was dissolved.[30]

A few French night reconnaissance escadrilles did come into existence before the end of the war. For example, in October

the First Army detachment was expanded into Escadrille V 293. With the training center in operation, Major Général Duval announced that escadrilles would replace all existing detachments. Additionally, when these units were equipped with faster, more capable aircraft (most likely the Bréguet 14 B 2), operational effectiveness would greatly improve.[31]

The Americans were less successful. As their projections for the formation of night reconnaissance squadrons had not been met, the USAS was forced to rely on French night bombardment aviation for reconnaissance assistance during the Saint Mihiel offensive. Soon after, on 27 September 1918, all USAS observation and two-seat pursuit planes were authorized to be equipped for night flying. Standard provisions for night scouting planes, as well as day observation aircraft, included bomb carriers for eight to 10 fragmentation bombs. Clearly these were meant for troop concentrations, convoys, and other soft targets. Allied airpower sought to maintain the ground initiative through round-the-clock harassment of the enemy.[32]

The USAS also had contemplated the use of FE2bs for night reconnaissance work during July 1918. The British had agreed to deliver a total of 114 of these aircraft to the Air Service, with roughly one-third of the number being delivered per month, beginning in September.

Since the USAS had been unable to secure any Handley Page aircraft, it considered the Voisin aircraft as a night bomber. Although USAS leaders recognized that the FE2b and Voisin aircraft were obsolete, the urgent need for night reconnaissance and bombing planes dictated such action.[33]

Night bombardment aircraft had performed satisfactorily in a reconnaissance role for much of the First World War. However, once the war of movement began during the spring of 1918, the Allies found day observation planes and night bombers could no longer supply their reconnaissance needs. The development of specialized Allied night reconnaissance units was essential for meeting Germany's next advance. Germany also recognized the valuable contribution that night observation offered when forced onto the defensive in the latter half of 1918. Night reconnaissance had become an integral element of air employment by war's end.

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Chapter 7

Men And Materiel for Night Flying

Night flying placed special demands upon both the airmen and the machines they flew. Takeoffs, landings, cross-country navigation, indeed the basics of flight could no longer be taken for granted. During the First World War, belligerents had to overcome immense challenges for successful military night aviation. Flying over the Western Front was difficult enough without the compounding factor of darkness. Yet by November 1918, sophisticated night navigation systems were developed and in place; an increasing variety of aircraft were being fitted and employed in night flying; and aviators were graduating from comprehensive training programs as night aviators. In the space of four years, night flying had gone from being a stunt of foolhardy exhibition pilots to an indispensable component of military plans for bombardment, pursuit, and reconnaissance aviation.

The evolution in night flying training may be understood by reviewing the developments in bombardment instruction since bombardment was the first and most widespread form of night aviation employed during the First World War. When war erupted in August 1914, France had two military aviation schools, Pau and Avord. Expansion quickly followed, with the aviation training centers becoming collectively known as the "Schools of the Interior." During 1915 the schools conceived the idea of graduating mission-ready pilots capable of day or night flying for pursuit, bombardment, and observation. Yet Avord did not have advanced bombardment and night flying training until April 1916. By this time, GB 3 was already recognized as a night unit. The group either developed its own unique training or had night instruction at the Groupe de Division d'Entrainement (GDE), the center for assigning aviators to escadrilles.[1]

French Bombardment Training

French bombardment training, like that of all the belligerents, was in a state of continuous evolution as the demands of combat and increasing technological capabilities required better trained, more specialized aviators. In 1917 the school at Avord offered advanced night bombardment training for Voisin and Caproni aircrews. Instruction included ground work on bombardment theory, navigation, and the rolling carpet. The rolling carpet was a treadmill painted to look like the ground when seen through a bombsight from a height of several thousand feet. Bombardiers sat on a wooden platform overlooking the carpet and released small darts (simulated bombs) to gain experience in bomb-sighting. Aerial instruction included bombing practice with live and dummy projectiles. Additional French bombardment schools were located at Cernon, Clermont-Ferrand, Le Crotoy, and Villeneuve.[2]

Due no doubt to the growing dependence on night bombardment, the French conducted night tests of Michelin and Gros bombs at Clermont-Ferrand during July 1916. The Michelin illuminating bombs proved satisfactory for lighting the target area. A longer lead time, to allow at least 200 to 300 meters vertical descent was recommended before flare ignition. This lead would ensure that the airplane was well away from the illuminated sky and remain undetected.[3]

The Gros Andreau 115 mm short-bomb testing was conducted from a height of 2,000 meters against illuminated targets one hundred meters in diameter. No bombs hit the target areas. The nearest strike was 90 meters distant. In the end, the trial "proved nothing conclusively, as to the accuracy of night bombing." The difficulties of precision night bombing were known from an early date. Undeterred by results, Ferdinand Gros, the bomb builder, attempted to justify the inaccuracy of night bombing. He asserted that targets of 500-square-meters size could be successfully bombed. Such objectives included cities, railway marshaling yards, camps, aviation grounds, and other open targets.[4]

Clermont-Ferrand offered training on the BM IV aircraft. By late 1917, the plane had become obsolete and was removed from French GBs. After basic and advanced flying instruction,

the bomber pilot entered the bombardment training division and was paired with a bomb thrower (bombardier) recruited from the School of Aerial Gunnery at Cazaux. Notably only the bombardiers with the "most serious general education" were selected due to the "delicate nature" of bombardment, especially night bombardment. The crew made three 150-kilometer cross-country flights navigating by map and compass. Quite likely these trips were made at night since the BM IV flew operationally only under cover of darkness.[5]

The concern with high-quality observers is a recurring theme in French night bombardment development during the war. Few pilots sought assignment to night bombing units. In fact many pilots considered it a disgrace. Most pilots wanted the glory associated with pursuit aviation; few looked forward to flying obsolete aircraft through the darkness. Because there were never enough volunteers to fill the requirements of night bombardment escadrilles, many pilot trainees of marginal capability were retained in flight instruction. With many pilots having a sour attitude toward night bombardment, authorities selected only the best observer-bombardiers.[6]

In addition to an "unshakable calmness and coolness" observers needed "a firm determination to reach the target, and a scrupulous conscience." Night missions were individual affairs whose results could not easily be verified. Authorities were forced to rely on the crews sense of duty to see that missions were accomplished. Since "the value of a night unit [was] never any more than the sum of the values of the individuals of the crew that compose it," high-caliber observer-bombardiers were a necessity.[7]

British Training

Apparently the situation was not much different in other countries. Upon being informed of selection for Handley Page training, an RFC pilot trainee could only ask, "Why me?" The reason was simple enough; he had an excellent record of takeoffs and landings. Certainly not all night bombardment pilots were frustrated fighter pilots—it only seemed that way.[8]

By the spring of 1916, General Trenchard decided his RFC aviators might benefit from night flying. The official British

historian notes that Trenchard was afraid that the Germans were getting too far ahead of the RFC in gaining such experience. Indeed both the Germans and the RNAS had been carrying out night bombing operations, albeit sporadic, for 12 months, and the French for better than six! Even the tiny Belgian L'Aviation Militaire carried out a night bombing mission against German bivouacs in the Houthoulst Forest during the previous summer. At the time, Trenchard was more concerned about the possibilities of aerial reconnaissance under the cover of darkness than with developing a night bombardment capability.[9]

The RNAS led the way in British night bombardment instruction. By October 1917 at least three RNAS schools, Cranwell, Frieston, and Manston, offered such training. One trainee recalled his first night flight in a Handley Page (at Manston) with nonchalance; it was of "thirty-three minutes duration and at an altitude of 2,000 feet." The RFC performed experimental night bombing work at Oxford, yet as late as October 1917 did not have an active bombardment training school.[10]

RFC pilot trainees saw little night flying in basic flight schools. Apparently, in early 1917, only BE2 and FE projected pilots were required to make two landings in the dark to graduate as flying officers. One such trainee, A. R. Kingsford, had 10 solo hours in FEs when "requested" to make the night landings. He was not pleased with the idea of "groping around in the dark trying to find the ground at its right level." Even less gratifying was his posting to No. 33 Home Defence Squadron. On arriving at the squadron, Kingsford was informed that the adjutant was away at a funeral—the result of night flying![11]

RFC night bomber crews were usually drawn from home defence squadrons in 1917. The crews went to France with an abundance of night flying but little formal bombardment instruction. Such was the case for Kingsford, who was transferred to No. 100 Squadron. He flew the same airplane, the FE2b, in both units.[12]

The RNAS often selected bombing teams from its aviators at Dunkirk. Once back in England, the teams progressed through several separate schools. The course contained the following stages:

1. ground work on bombs, carriers, and gears;
2. rolling carpet;
3. flights over bachelor mirror or camera obscura (for bombing practice without bomb-dropping);
4. cross-country flying by day and night;
5. bomb dropping; and
6. formation flying for day bombers.

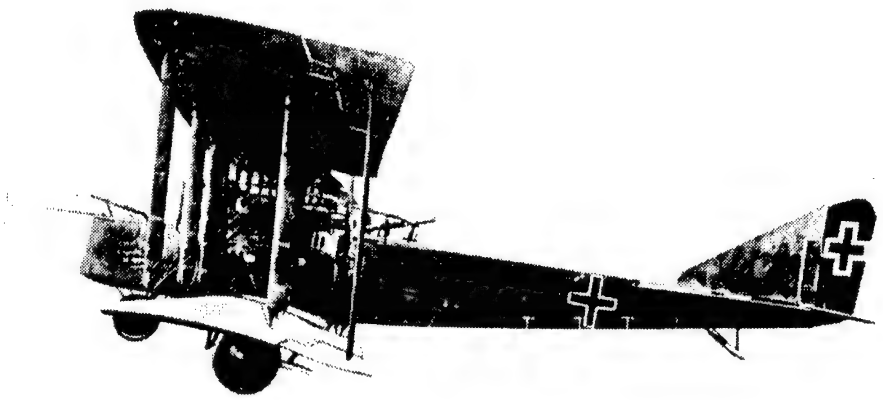
In 1918, the RNAS bombardment course was consolidated in what became (on 1 April) Royal Air Force No. 1 School of Navigation and Bombing, located near the ancient monoliths of Stonehenge.[13]

German Training

Similarly, the German air service developed a specialized Nacht-Bombenflieger-Schule at Paderborn, Prussia, for G-plane instruction. Training was given on the Gotha, Friedrichshafen, and Allgemeine Elektrizitäts Gesellschaft (AEG) versions of the bomber. Such training enabled crew members to quickly adapt to aircraft at the front. Aviators entering the school had already completed basic flight training at one of the numerous Flieger Ersatz Abteilungen or Militär Fliegerschulen.[14]

Students first took the G-planes into the air during daylight to gain experience in handling the large aircraft. Then came twilight flights in smaller dual-controlled C-planes; eventually the trainee made takeoffs and landings during total darkness. With this experience, the bomber students began G-plane night flights accompanied by an instructor. Finally solo flights commenced, sometimes with fatal results.[15]

Apparently the citizens of Paderborn appreciated night flying as much as many of the trainees—it disturbed their sleep! Responding with typical Prussian candor, the deputy general commanding the Seventh Army Corps suggested that the townspeople compare their lack of sleep due to aviation training to that experienced by the citizens of Metz, where "not only is the night's rest disturbed by their own aerial activity, but also by bomb raids by enemy airmen." In other words, get used to the noise.[16]



Friedrichshafen

R-plane training was totally separate from the instruction at Paderborn. The Riesenflugzeug Schulabteilung was formed at Vilna during the summer of 1917 after Rfa 501 had transferred from the base to the outskirts of Berlin. Rfa 501 personnel learned how to operate the new Staaken R.VI aircraft. The training section at Vilna used older SSW R-planes for instruction. Additionally a Riesenflugzeug-ersatzabteilung (Rea) was established at Döberitz with three SSW R-plane training ships. The R-Schulabteilung at Vilna closed around January 1918, being replaced by a new Rea at Cologne.[17]

The Americans

In June 1916 the United States Army began night flying in earnest, and included it for the first time in the training curriculum at the Signal Corps Aviation School, North Island, San Diego. Such instruction was initially limited to moonlit nights. Later, training was carried out on dark nights with only the lights of San Diego harbor for landing assistance. The Signal Corps aviation school at Mineola, New York, conducted

bombing experiments and had planned extensive research into night flight at the time of America's entry into the war. Day and night bombardment training was eventually limited to Ellington Field, Texas.[18]

Several American air officers went to Paris in April 1917 to coordinate the US entry into the air war. Since US facilities were incapable of meeting the rapid influx of trainees, Capt Joseph Carberry recommended the establishment of American flying training in France. Four specialized schools were envisioned, with one for day and night bombardment instruction. Until the schools could be established, the United States made an agreement for training of night bombardment units at the French school at Cernon. After completing instruction, the USAS night bombers were to be sent to the front for battle training with GB 1 commanded at that time by Commandant Victor Jean-Marie Chabert.[19]

Ostensibly, the transfer of the French bombardment school at Clermont-Ferrand to the USAS in November 1917 made such a scheme unnecessary. Clermont-Ferrand became known as the Seventh Air Instruction Center (AIC), with the first night flying attempted during February 1918. Unfortunately the mountainous terrain surrounding the field made forced landings too risky, and night instruction was soon discontinued. Night training at the Eighth AIC, Foggia, Italy, proved even less satisfactory.[20]

On 26 January 1918 General Foulois entered into an agreement with the British air minister for the training of American night bombardment personnel. Additionally facilities were to be supplied for the assembly of US-manufactured Handley Page component parts. The original accord called for 30 long-distance night bombardment squadrons to be organized in Great Britain. However progress was slow; the prototype American-built Handley Page bomber, the Langley, was not completed until July 1918.[21]

The British allowed the USAS to open an American-operated Handley Page training school in England. Four aerodromes in varying stages of completion (Emeworth, Ford Junction, Rustington, and Tangemere, collectively known as the Chichester Area) were turned over to the USAS until Handley Page night bombardment training schools were fully

operational in the United States. The objective of the Chicester Area was to furnish completely trained night bombardment squadrons for the front.[22]

The school at No. 1 Field (Ford Junction) was opened on 15 August 1918 although instruction was delayed until at least 20 September due to lack of aircraft. Of 20 to 30 airplanes received at Ford Junction, only one was a Handley Page and it arrived just before the armistice. Activities at Ellington Field were realigned to provide Ford Junction with trainees well versed in night flying. The final three weeks of the Texas-based program included advanced night flying, night bomb-dropping, and practice night bombing raids. Nevertheless the United States failed to attain its goal of operational night bombardment squadrons before the armistice.[23]

Aircraft Instrumentation

Just as the training of airmen for night flying advanced throughout the war, so to did the capabilities of night-flying aircraft. The most basic necessity for night-flying aircraft was a simple means of instrument illumination. The use of hand-held flashlights proved cumbersome and inconvenient for aircrews, yet the pilot needed to know what his instruments were reading. Much experimentation was required since individual aviators complained that the illumination was either too strong or too weak.

One of the earliest methods involved placing small electric light bulbs behind translucent instrument dials. During the war, the most extensive research involved the use of self-luminous materials, namely a combination of zinc sulphide and radium. These were applied to instrument dials as paint, and the instruments could then be read solely by their phosphorescent glow.[24]

Luminous materials were well-known before the First World War. Adding a small amount of radium caused a responsive base to remain in a state of continuous stimulation due to alpha particle bombardment, hence the term *self-luminous.* Controlling the brightness of self-luminous material proved quite difficult. A host of other limiting factors, including the resolving power and sensitivity of aviators' eyes, confounded

the scientists. Nevertheless self-luminous paints were used widely for night instrument illumination during the First World War (fig. 5).[25]

The final scheme for night illumination of aircraft instruments was the use of small, shielded incandescent lamps placed next to the dials. Importantly, these lamps could be turned on and off as needed. However engine vibrations often caused light bulbs or electrical connections to fail. Even the small amount of light emitted by such lamps could cause great difficulty for novice night aviators since it could be too dazzling.[26]

Willis Fitch recalled that on his first Caproni night solo, the plane kept rolling into steep dives for no apparent reason. Frantically trying to figure out what was wrong, Fitch caught a glimpse of light above his head as he was trying to pull the aircraft out of yet another dive. Glancing up at what he presumed to be the moon, Fitch was shocked to discover the light was being emitted from an aircraft hanger. He was flying upside down! Turning the wheel for all he was worth, the pilot found great relief after the hanger lights once again "rested on the ground where they belonged." Fitch's control problems resulted from inadvertently having left the instrument board illuminated during flight, and the glare hampered his night

Figure 5. Trade Advertisements for Self-luminous Compounds, 1917

vision. One can only wonder how many crashes resulted from similar circumstances.[27]

Special aircraft instruments were developed specifically for night flying. One example is the Jenkins Night Altitude Indicator. The indicator, developed in Great Britain, determined height above ground level (to 500 feet) through the use of three optical projectors, two of which were fixed in positions parallel to each other. The third projector was rotatable; its light shaft moved between the two fixed projectors as the plane decreased in altitude. Plans called for incorporation of the Jenkins indicator as standard equipment on Handley Page night bombers. Nearly five years after the war, experiments were still being conducted to determine its value to civil aviation.[28]

Signaling devices were necessary for communications with the ground. The flare gun provided the most basic means of signaling. The Allies used the Chobert, more commonly known as the Very pistol. British and American night squadrons used three different colored Very cartridges, red, white, and green. Each cartridge had a different milling along its metal base flange so that aviators could quickly feel for the correct shell in the dark.[29]

To determine friend or foe, Allied AAA batteries challenged planes by using a searchlight to signal the Morse code letter of the day. The aircrew responded by firing a Very pistol loaded with the color of the day, which was changed at least daily. If the wrong color was fired or the plane failed to respond, the AAA was authorized to fire on the aircraft. The signal pistol was also a key element for communication between ground personnel and aircrews during the takeoff and landing phases of night operations.[30]

During the war, aircraft-mounted searchlight experimentation and application were extensive. The lights, powered by dynamo or battery, offered adequate means for night landing, communication between aircraft, and signaling from air to ground. However their use by night pursuit planes for sweeping the sky to locate enemy aircraft proved quite unsatisfactory.[31]

More often than not all that was accomplished was showing oneself to the enemy. One author noted that in the Paris

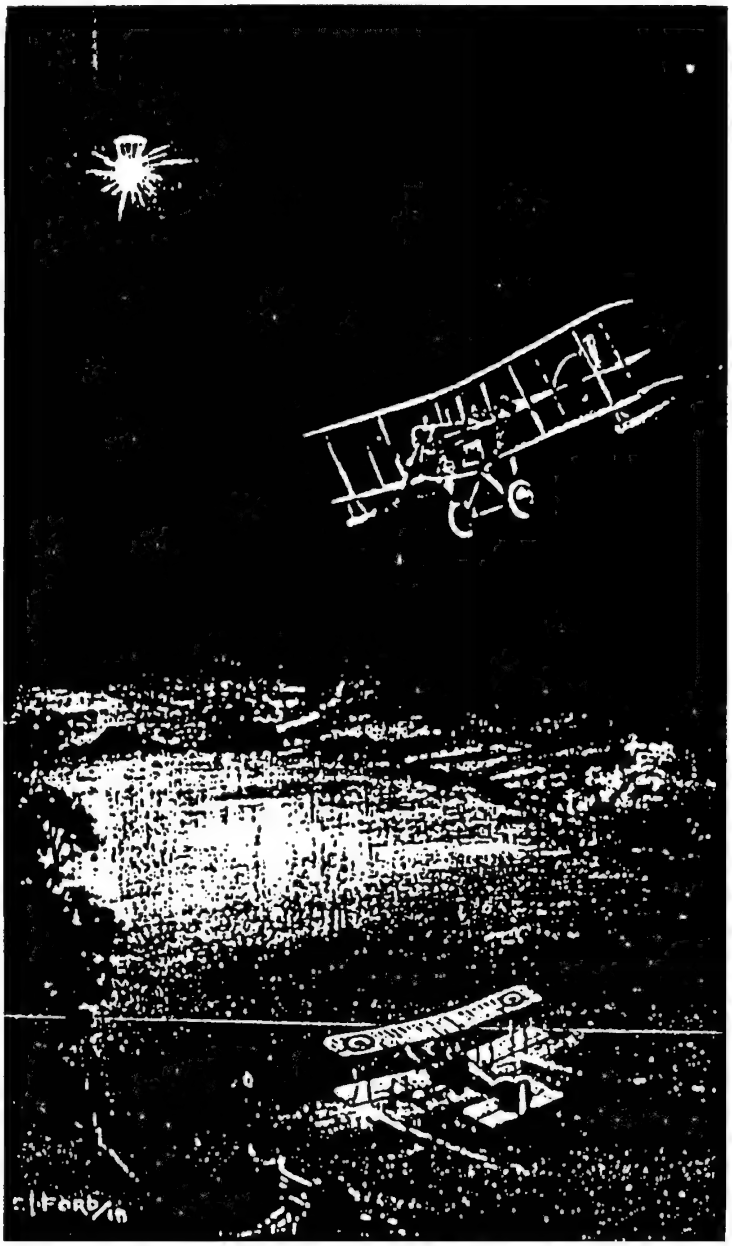
nighttime sky, it was a common sight to see aircraft flying with their projectors (searchlights) illuminated. He contended that the hunter had now become the hunted, sarcastically noting that with "all these luminous targets, it would be possible to become a Guynemer in a single night." Nevertheless, airplane-mounted projectors became standard equipment for many aircraft during the war.[32]

Targeting and Landing Illumination

Illuminating flares were developed for target acquisition and landing assistance. One of the most important was the Holt wingtip landing flare. Useful in an emergency or under inadequate field lighting conditions, the Holt flare was ignited electrically (by dry cell battery) from a push button in the cockpit. Typically the flare would burn for a maximum of two minutes at up to 20,000 candlepower. However, the flares were used cautiously, as a crash or hard landing could bend the bracket and cause burning magnesium to ignite the wing. To reduce this hazard, brackets were later devised with a hinged base and elastic cord. The flare could move backward if the plane rocked on landing and the wingtip touched the ground, and the elastic cord would spring the bracket back into its original position.[33]

Obviously once the flare ignited, it continued to burn until its fuel was exhausted. Such lack of operational flexibility ensured that its improper use could have serious consequences. At least one instance was noted of a Holt flare being inadvertently lit over enemy territory. Pilots flying tractor aircraft found themselves blinded by the glare reflected off the propeller. Henceforth propellers were painted a dark, flat brown or black. Additionally, pilots found that one burning flare worked best since they could look over the opposite wing during approach without being blinded. Due to the ever present danger that a flare might burn out before the plane landed, Holts were ordinarily used in conjunction with larger parachute flares, sometimes referred to as illuminating bombs (fig. 6).[34]

The Michelin parachute flare was the most widely used Allied flare of its type. Because the flare burned for seven to 11 minutes when deployed at altitude, it was very useful during



Source: Drawn by E. L. Ford, in W. G. McMinnies, *Practical Flying* (London: Temple Press, 1918).

Figure 6. Sketch Showing Wing Tip and Parachute Flare Use for Night Landings

forced landings; however, the flare was primarily intended for target illumination. Another French-designed illuminating bomb, the Bourges lighting grenade, was favored by night reconnaissance aircrews because of its smaller size. The British and Americans experimented with illuminating-type bombs but relied upon the Michelin for wartime night operations.[35]

Germany developed similar flares for night operations. Their Leuchtbombe mit Fallschirm was produced in 60 cm and 90 cm varieties and burned for about two minutes when deployed from a height of 300 to 400 meters. Another flare was much used by naval airships over the North Sea; the flare illuminated only upon contact with water. The use of parachute flares was crucial for exploiting night operations to their fullest.[36]

Ground-based systems provided necessary assistance for night navigation and landing. One of the most interesting developments was the system of aerial lighthouses on both sides of the Western Front. Germany built the first such lighthouse at Johannistal, in October 1913 and later improved on the idea with the creation of intermittent beacons. Individual lighthouses could emit a unique light sequence which made identification simple. The sequence could be changed as the situation warranted. Lighthouses flashed either Morse code letters or numbers during the war (fig. 7). Even though electrical power was the preferred power source for lighthouse operation, many lights were powered by acetylene or other gases.[37]

The French established a string of high-powered light stations located between 15 and 25 kilometers behind the front and 30 kilometers apart. The radiance from these sites was visible for up to 100 kilometers under optimum atmospheric conditions. Less intense lights (visible for 40 kilometers) were located at emergency airfields further behind

Source: Alfred Gradenwitz, "Lighthouses for the Aerial Navigator: Guiding the Airman at Night," *Scientific American* 110, no. 20 (16 May 1914), 411.

Figure 7. Sample German Lighthouse Signals, 1914

the lines. These lights acted as intermediate guides for night fliers, directing them toward the front. Although mobile, the lights were nevertheless cumbersome to move, difficult to install, and fragile. Under poor climatic conditions, the ground lights were often "barely visible from ten miles." Yet they were a welcome sight for the aircrews returning from missions. One aviator recalled that "France, from the air at night, was . . . a sea of blackness, except for the 'dummies' and the 'lighthouses'" (see table 16).[38]

The German system of navigational aids was much more elaborate. In addition to a series of lighthouses, lights in the shape of stars, crosses, triangles, or the letter "T" were used to steer night bombers toward their objectives. These lights were visible from 10 to 60 kilometers depending on weather

Table 16

Location of French Lighthouses, 10 June 1918

No. Location of Lighthouse	Hill No.	Orientation	To Front
1. Mont des Récoltes	167	N.78.E.	20km
2. 5km S.20.W. of Houdain	191	N.85.E.	20km
3. 8km S.20.W. of Doullens	170	S.69.E.	22km
4. 4km W. of St. Just-en-Chaussée	178	N.51.E.	18km
5. 9km N.60.W. of Villers-Cotterets	238	N.61.E.	16km
6. 4km E. of Montmirail	235	North	24km
7. 11km N. of Chalons	152	N.18.W.	20km
8. 1km S. of Clermont-en-Argonne	308	N.12.W.	15km
9. 12km N. of Bar-le-Duc	375	N.34.E.	20km
10. 12km S. of Nancy	402	N.16.E.	20km
11. Mount d'Essey	420	N.43.E.	15km
12. 4km S.20.W. of St. Dié	768	N.60.E.	20km
13. Balloon *Alsace ?*	1248	N.76.E.	25km
14. 4km E. of Hérimoncourt	614	N.66.E.	18km

Source: Adapted from "Emplacements des Phares de 100 Kilometres, a la date du 10 juin 1918;" and "Balisage de Nuit du Front," 12, World War I Night Aviation Collection, SHAA.

conditions. The German system also employed aerial signals. Luminous balls, commonly referred to by Allied aviators as "flaming onions," fired from a 20-millimeter cannon reached an altitude of up to 2,000 meters. The "onions," or "lovely necklaces of flaming jade" as one RNAS aviator referred to them, could be fired in thick chains or spaced to form Morse code letters so that each location could be identified. Furthermore, luminous shells of various colors were fired from heavy-caliber guns. The shells deployed a parachute and were visible from 50 to 100 kilometers. The Allies lacked a similar aerial scheme.[39]

Radio Direction Finding

Any discussion of aids to night aviation during the First World War would be incomplete without commenting on the use of radio-direction finding (RDF) for long-distance flying. German prewar radio experimentation with zeppelins paid off on the night of 15 June 1915 when airship L10 used bearings from the RDF stations at Nordholz and Borkum to triangulate its position over England. Curiously, the airship called the stations which then plotted the direction of the signals and radioed them back to the zeppelin. Though the British were also able to intercept the airship transmissions and determine its position, the system remained in effect until 1918. Then German RDF stations began to send transmissions to the now silent airships. The French had considered a similar system for its bombardment aviation, with ground RDF personnel making calculations from signals emitted by the aircraft, but considered the mode too unreliable. Presumably the French went along with British developments in the field.[40]

In early 1918 the British experimented with RDF systems for night-flying airplanes at Andover Junction and Cranwell. Guiding Allied bombardment aircraft to and from Berlin was to be the main purpose of British RDF. The USAS ordered 550 sets of direction finding apparatus for its night bombers. Additionally, students at the bombardment school at Ford Junction were instructed in night navigation by means of RDF. The armistice prevented widespread Allied use of RDF.[41]

An aviator could now take off at night, fly to the objective with the assistance of ground and aerial air navigational aids,

illuminate the target with parachute flares, drop bombs, fly back across the lines, answer challenges from friendly AAA batteries, and arrive home. A simple landing was all that remained for successful mission completion. Unfortunately night landings often proved more hazardous than the enemy searchlight and AAA barrage. Holt flares were useful but safer airfield lighting was needed.

Airfield Illumination

When Capt Charles DeF. Chandler flew to the US Signal Corps airfield at College Park, Maryland, late on 1 June 1912, the ground mechanics, not expecting the aviator to return to the field after dark, resorted to throwing "oil and gasoline on the field" and igniting it to aid in his landing. Such temporary measures for lighting landing fields were as common as night flying was rare. The lack of any systematic airfield illumination was a limiting factor in the development of military night aviation. However, experimentation with aerodrome lighting soon began to pay dividends. Organized airfield illumination rapidly matured in the decade between Wilbur Wright's first night flight and the end of the war.[42]

Remarkably, one man, Clement Ader, had foreseen the importance of military night aviation as early as the 1890s and set out to develop a permanent system of airfield illumination. During night operations, Ader called for outlining an airfield's landing zones with "beacon fires of special color, placed in little holes and covered at ground level by grills." Smoke from fires near the landing zone would provide a visual indication of wind direction. Furthermore, electric lamps could replace the fires so the entire field could be illuminated or darkened as "tactical considerations" warranted.[43]

Supplementary beacons located at a distance from the aerodrome and oriented due north, south, east, and west of the field could serve as directional aids for night cross-country flying. Unfortunately French military leaders failed to take Ader's recommendations seriously since extensive night flying appeared impractical. Undoubtedly to Ader's chagrin, his ideas found expression in a similar scheme enacted by the Germans during the First World War.[44]

An illumination system consisting of a series of sunken electric lamps, providing the night flier with both airfield location and wind direction, was developed at Johannistal aerodrome. A large square glass window, flush with the ground and thick enough to withstand the impact of an aircraft landing, was positioned at the center of the airfield. At night an electric lamp located beneath the glass continuously radiated white light into the darkened sky, acting as a beacon to guide the night flier. Located at a distance of 250 feet from the central lamp were eight smaller submerged red lamps (fig. 8). Connected by underground cable to a weathervane, these outer lamps automatically switched on or off as the vane turned into the wind, thereby offering a visual indication of the wind direction. For instance, if the wind was from the east, in addition to the central white lamp, only the red lamp located to the east would be illuminated. If the wind was blowing in a direction between cardinal points, the two outer lamps closest to the actual wind direction would light up. The fixity of such a system undoubtedly limited its use to permanent aerodromes in the interior of Germany, such as Johannistal.[45]

Petrol flares (cans filled with petrol and waste, later asbestos and parrafin) were the standard fare for British

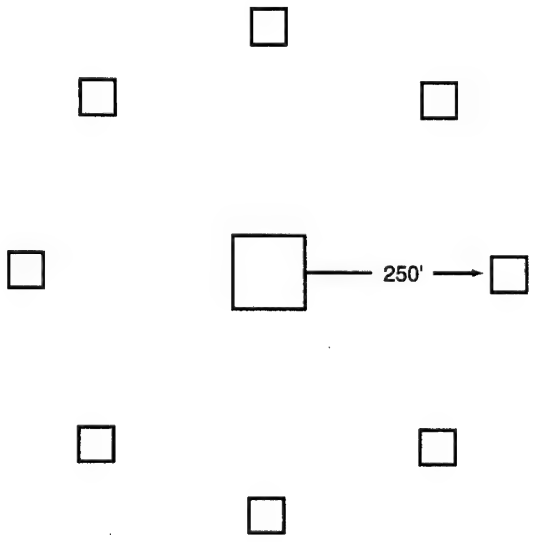
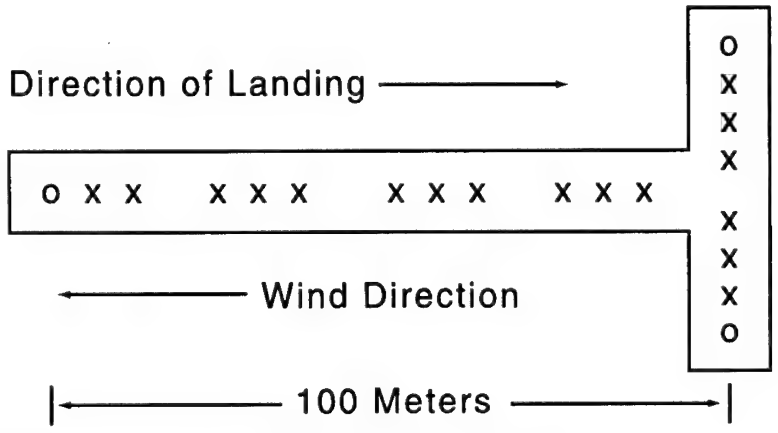


Figure 8. Plan for German Airfield Illumination, 1915

aerodrome illumination for much of the war. The flares were routinely placed in the shape of an L, with the long side of the letter positioned parallel to the wind. Takeoffs and landings were then made toward the base of the letter. The scheme provided an inexpensive and mobile system of night airfield lighting.[46] Various airfield lighting schemes using electric lamps were developed by the Allies. By the end of the war, the most widely used system was the electric "TEE" (fig. 9). Approximately 100 meters in length by 50 meters wide, the TEE proved quite successful. As in the L flare system, the long side of the T was situated parallel with the wind with the top of the letter facing into the wind.[47]

The French regularly used the Crochat Electric Field Illuminating Truck. The system was completely mobile. In addition to spotlights mounted on the vehicle, six portable 33-cm Brandt projectors, placed atop adjustable tripods, provided enough lighting for night aviation operations. The USAS tested its own prototype of an airfield lighting truck at Ellington Field only months before the armistice. Such mobile lighting systems were important during the "war of movement."[48]

Aviators were now able to bring their planes home safely. Improved training requiring hours of night flying gave airmen



Source: "Airdrome Field Electrical Equipment For Night-Flying Squadrons," *Air Service Bulletin* 6, no. 286, 26 September 1918, Gorrell, vol. L-10.

Figure 9. British "TEE" Electric Airfield Light System

the experience necessary for successful military operations under cover of darkness. Advances in ground and airborne aids improved the efficiency and security of such missions. Night military aviation was clearly dependent upon the progress in both technology and training for its mastery during the First World War.

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39. "Signalisation de Nuit," 5 October 1918, World War I Night Aviation Collection, SHAA; Bewsher, 127.

40. Robinson, 72; Petitalot, 241.

41. "Final Report of Chief of Air Service, AEF," Gorrell, vol. A-29, 128; 1st Lt Henry N. Wolff, memorandum to 1st Lt J. Parker Van Zandt, 3 September 1918, Gorrell, vol. B-6, 258–59; "Navigation to be used in connection with radio direction finding for aircraft," lecture, Gorrell, vol. J-5; "Direction Finding by Radio: Maximum Method Using Two Coils Especially Adapted to Use on Airplanes," *Air Service Bulletin* 4, no. 175, Gorrell, vol. J-5.

42. Hennessy, 61.

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Chapter 8

Conclusion

Bold individuals first tackled the darkened skies in balloons and dirigibles. Airplane pilots later thrilled crowds with intrepid nighttime exhibitions. Although such demonstrations were considered foolhardy and even eccentric by many segments of society, they nevertheless provided the impetus for military experimentation in night flying. The fragile nature of prewar aircraft and the unsophisticated state of support equipment limited night capabilities. Hence, military authorities remained unconvinced of the usefulness of flying airplanes under cover of darkness. Only the rigid airship appeared to be a practical nocturnal voyager.

The First World War quickly exposed the vulnerability of airships both day and night. Even small arms fire proved hazardous to the early low-ceiling dirigibles. Bright moonlit nights offered little refuge to these lumbering giants. While improvements allowed the airships to climb higher into the nighttime skies, bombing accuracy decreased. The airship, although remaining a terror weapon for much of the war, ultimately proved inferior to the airplane for military use.

Night airplane activity in the early days of the First World War was limited to sporadic bombing raids that were mainly individual actions with the sole purpose of harassing the enemy. As improving technology caused rapid obsolescence of aircraft, the nighttime skies began to become a safer haven for such airplanes. The synchronized forward-firing machine gun, perhaps the most significant development in aerial armament during the war, banished an entire class of aircraft, the pushers, into the night. For the balance of the war, aerial bombardment remained heavily nocturnal.

Still night military aviation was a "poor relation" to its daytime counterpart. Air service leadership failed to press for development of strictly night-capable aircraft since obsolete airplanes performed adequately in such a role. Unfortunately, the outdated aircraft often possessed unreliable motors which made forced landings a perennial concern of aviators. Night

flying was further hampered by a lack of such complementary equipment, as illuminated cockpit instruments (see table 17). Finally night bombardment, which was the essential element of night military aviation along the Western Front until 1918, was commonly considered by military authorities as a "dumping ground" for mediocre pilots. Could there be much surprise that morale was often poor in night bomber units?

Table 17

Specifications for Night Reconnaissance Planes

1. Two Compasses - luminous dials, one for each cockpit.
2. Two Clocks - luminous dials, one for each cockpit.
3. One Tachometer.
4. One Airspeed Indicator.
5. Two Altimeters - one for each cockpit.
6. Four Holt flare brackets on each lower wing underneath, and completely wired to pilot's cockpit and connected to Holt flare push button. These brackets to be placed as near the extreme side of lower wing as possible.
7. Two Landing Search Lights - midway between fuselage and wingtip on upper side of lower planes - type of light used on D.H. and Bréguet (Cibie) completely wired and equipped with storage batteries.
8. Navigation lights - one red and one green - mounted in proper receptacle on wingtip struts and completely wired to pilot's cockpit.
9. One Intercommunicating electric telephone set.
10. One Incidence indicator - pilot's cockpit.
11. One Banking indicator - pilot's cockpit.
12. One Inclinometer - pilot's cockpit.
13. Dash lights for gauges in front.
14. Two portable socket lights for rear.
15. Full wireless equipment for two keys in rear cockpit.
16. Machine guns - one fixed synchronizing on nose - two on air turret - observer.
17. For A.R.2 planes, speaking tubes instead of electric telephone. Guns - one top plane mount and two on turret.

In case of necessity on rush order, these planes will be equipped only with items 3, 4, 7, 8, 10, 13, 14, and 16.

Source: Adapted from "Specification for Night Reconnaissance Plane," Production and Maintenance Division, Inspection Department, ASPC no. 2, n.d. [after 12 August 1918], Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919,* National Archives Microfilm Publications, no. 990, vol. 1–15 (Washington, D.C.: National Archives and Records Administration, 1974), 123.

Germany suffered from a deficiency of bomber aircraft due to a preference in military circles for airship development. The Zeppelin was an extremely visible symbol of German ascendancy in the heavens. Yet 17 airships were lost over Great Britain and more than 60 others were destroyed through hostile and nonhostile action during the course of the war. In the end, the night offered the dirigible little protection. Had much of the massive monetary investment drained by airship construction been used for increased research, development, and deployment of heavy bomber aircraft, German night bombardment aviation might well have played a more decisive role in the events of 1914–1918.[1]

France was constrained by geography and aircraft limitations to the strategic bombardment of the Briey Basin. The basic problem was that numerous French cities were vulnerable to German reprisals. Hence the railways and industry of the basin were the only strategic options for the night bombers of the French air service. Tactically German airfields were important targets for French bombers.

Slow to switch to night operations, the RFC was forced to adopt a strategic role for its bombardment aviation due to RNAS successes and the British desire for reprisals against German cities. Only grudgingly did the RFC incorporate the Handley Page heavy bomber. As late as August 1917, General Trenchard opposed the use of the twin-engine bombers. Fully 40 percent of Independent Forces RAF bombs (220 of 543 tons) were directed at German airfields. Railway targets constituted a primary objective for the short-range FE2b aircraft. Bombing of industrial targets in German cities was simply not a major activity. Therefore on closer examination, the French and British bombing campaigns were not as disparate as would first appear.[2]

The German bombing campaign against Great Britain failed to reduce British war resolve. Sporadic night attacks, which were thought to be especially demoralizing, could not break the will of the people. The German strategic campaign was continually hampered by the need for tactical bombing on the continent. The number of aircraft flying against the British Isles was always a minority of the German bomber force. In

fact the bombers of Bogohl 3 were often used for tactical missions, especially during the spring 1918 offensives.

Since the British were compelled to invest heavily in home defense, they had an early background in night interception. One author contends that the equivalent of 10 full-strength fighter squadrons and two or three short-range bombardment squadrons (that could have been formed on the Western Front) were tied up in home defense duties. Germany, already outnumbered on the front, could have ill-afforded such an addition to the enemy camp. Thus the German decision to conduct the strategic bombardment of Great Britain was not totally in error.[3]

Night reconnaissance and night pursuit both performed important duties during the last year of fighting. The airplane brought about a fundamental change in warfare by forcing armies to make their movements and preparations under cover of darkness. Additionally, concealment and deception had to be carried out far behind the lines to mask intentions. Four years after the war, a young USAS test pilot, Lt Muir S. Fairchild, argued that "in a future war Night Reconnaissance [would] be of fundamental importance." Such an assessment was supported by the operations of 1918. Yet Fairchild lamented that the USAS did not "seem to regard Night Observation aviation as deserving of the importance" it clearly warranted.[4]

Night pursuit was a logical supplement to searchlight and antiaircraft artillery defenses. Airplanes illuminated by searchlight were attacked with little difficulty by fighter aircraft. Interception without searchlight assistance was more difficult, yet possible. At the time of the armistice, night pursuit was evolving rapidly. Unfortunately the hard-earned lessons of night flying along the Western Front appear to have been lost with the military force reductions after the First World War.

Strategic bombardment aviation experienced a reduced loss rate during night operations, with little apparent difference in bombing accuracy as compared to that of daylight missions. Yet both the British and American air forces insisted on emphasizing daylight strategic bombing operations during the interwar period and into the Second World War. Aircraft losses quickly forced the British to return to the nighttime skies;

however, the United States steadfastly refused to alter tactics even after it became apparent that the "bomber would not always get through." Was this attitude due in part to the fact that the United States had no combat night bombing legacy from the First World War? Here perhaps is the great paradox of World War I night flying.

Night fighting received scant attention in the interwar years. The French closed their night fighter instruction center three months after the armistice. The British failed to exploit the advances produced by years of home defense activity. One author contends that the first true night fighter did not enter the RAF inventory until 1956. Both the Germans and Americans made great strides in night fighting during the Second World War. These achievements were not due to a systematic study of night fighting during the interwar years. Especially in the case of Germany, night pursuit was once again too little too late.[5]

It should now seem obvious that the Western Front belligerents failed to appreciate or conserve the lessons of night flying learned during the First World War. Diminished military budgets in the interwar period inhibited air service development and training, and resulted in a reduction of night flying. Additionally, there appeared to be a subtle implication that aerial combat operations under cover of darkness were less chivalrous than in open daylight. For these reasons, and undoubtedly many others, western military aviation entered the Second World War unprepared to exploit the nighttime skies.

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2. Walter A. Raleigh and H. A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 6 (Oxford: Clarendon Press, 1928), 158–59, 167.

3. Alex Imrie, *Pictorial History of the German Army Air Service, 1914–1918* (Chicago: Henry Regnery, 1973), 48; Cole and Cheesman, 446–51.

4. Muir S. Fairchild, "Notes on Type VIII Night Observation," 26 October 1922, Fairchild Collection, HRC.

5. Bill Gunston, *Night Fighters: A Development and Combat History* (New York: Scribner, 1976), 9–11.

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